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(54) LIGHT TRANSMISSION PLATE, POLARIZATION SURFACE LIGHT SOURCE DEVICE AND REFLECTIVE LIQUID CRYSTAL DISPLAY DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To develop a light transmission plate and a polarization surface light source device for forming a front light type reflective liquid crystal device which is excellent in visibility such as contrast or brightness and suppresses the deterioration or the dispersion of luminance in a lighting mode even when a reflection preventing layer consisting of a circular polarizing plate is formed.

SOLUTION: The light transmission plate is constituted by arranging an optical sheet (1C) provided with at least a polarizer (1C1) via a transparent layer (1B) which is an independent body of an adhesive layer with a refractive index being smaller than that of a planar body (1) by ≥0.07 on the lower surface of the planar body emitting an incident light coming from an incident side surface from the lower surface via a light emitting means (A) formed on the upper surface. A polarization surface light source device (10) is constituted by arranging a light source (2) on one or two or more incident side surfaces on the light transmission plate. The reflection type liquid crystal display device (100) is constituted by arranging a liquid crystal cell (20) having a reflection layer (202) at the light emission side of the polarization surface light source device.

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CLAIMS

[Claim(s)]

[Claim 1] The light guide plate characterized by coming to arrange the optical sheet which a refractive index is [0.07 or more] lower than the plate, and possesses a polarizer at least through the clear layer of another object with an adhesives layer on the inferior surface of tongue of the plate which carries out outgoing radiation of the incident light from an incidence side face from an inferior surface of tongue through the light emission gunner stage formed in the top face.

[Claim 2] The light guide plate with which the light emission gunner stage on the top face of a plate consists of plurality of the crevice of a triangle or a square, or heights in claim 1 based on the cross section.

[Claim 3] The light guide plate with which the light emission gunner stage on the top face of a plate possesses the optical-path conversion slant face of 35 - 48 tilt angles to a base plane at the bottom in claim 1 or 2.

[Claim 4] The light guide plate with which the optical-path conversion slant face of a light emission gunner stage meets an incidence side face in claim 3.

[Claim 5] It consists of structure which the crevice or heights of a cross-section triangle which a light emission gunner stage becomes from an optical-path conversion slant face and a gentle slope adjoined in 50 micrometers - 1.5mm pitch in claim 3 or 4, and the tilt angle of said gentle slope to a base plane at the bottom is 10 or less degrees. The light guide plate whose projected area of the gentle slope to a base plane at the bottom is 5 or more times of that of an optical-path conversion slant face while the angular difference of the whole is less than 5 times and the difference of the tilt angle concerned in a nearby gentle slope is less than 1 time.

[Claim 6] The light guide plate whose area which it consists of structure over which the crevice or heights of a cross-section triangle which a light emission gunner stage becomes from an optical-path conversion slant face and a steep incline set spacing, and was distributed in claim 3 or 4, and the aforementioned steep incline has the tilt angle of 60 degrees or more to a base plane at the bottom, and is occupied on the top face of a light emission gunner stage is 1/5 or less.

[Claim 7] The light guide plate with which a light emission gunner stage consists of a crevice in claim 6.

[Claim 8] The light guide plate the shorter side lay length of whose is 40 micrometers or less based on projection of on claims 3-7 and as opposed to the inferior surface of tongue of an optical-path conversion slant face.

[Claim 9] The light guide plate whose crossover include angle of the normal to an optical-path conversion slant face and the normal to an incidence side face is 0 - 30 degrees when it sees from a top-face side in claims 5-8.

[Claim 10] The light guide plate the long side lay length of whose is 5 or more times of shorter side lay length based on projection of on claims 6-9 and as opposed to the inferior surface of tongue of a light emission gunner stage.

[Claim 11] The light guide plate the long side lay length of whose is 1mm or less based on projection of on claim 10 and as opposed to the inferior surface of tongue of a light emission gunner stage.

[Claim 12] A light guide plate with irregular distribution [in / on claims 6-11 and / the top face of a light emission gunner stage].

[Claim 13] The light guide plate with which an optical sheet possesses the phase contrast plate more than one layer or two-layer in one side of a polarizer, and the polarizer is located in a plate side in claims 1-12.

[Claim 14] The light guide plate with which an optical sheet possesses the phase contrast plate of 100-150nm of phase contrast one layer or more than two-layer in claim 13.

[Claim 15] The light guide plate whose phase contrast of the phase contrast plate an optical sheet possesses the phase contrast plate more than two-layer in claim 13, and is 100-150nm or 200-300nm.

[Claim 16] Plane-of-polarization light equipment characterized by coming to arrange the light source on 1 or two or more incidence side faces in a light guide plate according to claim 1 to 15.

[Claim 17] The reflective mold liquid crystal display characterized by coming to arrange the liquid crystal cell which has a reflecting layer in the optical outgoing radiation side of plane-of-polarization light equipment according to claim 16.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the plane-of-polarization light equipment using the light guide plate and it which are excellent in the use effectiveness of light and can form a bright and legible reflective mold liquid crystal display.

[0002]

[Background of the Invention] The front light-type reflective mold liquid crystal display which has surface light source equipment which consists of a side light mold light guide plate which enables the check by looking in an umbra etc. in a check-by-looking side was known (JP,12-111900,A). By the front light formula, since display light will be checked by looking through a light guide plate, properties, such as not carrying out outgoing radiation of the leakage light to a check-by-looking side, that the outgoing radiation light from an inferior-surface-of-tongue side is excellent in the directivity of the direction of a normal, not disturbing a display image, without scattering the transmitted light from a top face at the time of a check by looking, and the use effectiveness of light being high and excelling in brightness, are required of the light guide plate.

[0003] Moreover, in a reflective mold liquid crystal display, the outdoor daylight reflection by the light guide plate, especially reflection on the inferior surface of tongue lap with the specular reflection in a liquid crystal cell side, especially it is easy to reduce the display grace in outdoor daylight mode. Therefore, a circular polarization of light plate etc. is arranged for the purpose of

this acid resisting. This reverses the circular polarization of light through a circular polarization of light plate in a reflector, and makes the reflected light absorb. As a circular polarization of light plate, the layered product of a polarizer and a quarter-wave length plate is used usually, and according to this, it can be made to serve as the polarizer for a display with acid resisting in locating a polarizer in a light guide plate side. Moreover, not only the reflected light under a light guide plate but reflection in a liquid crystal display front face can be prevented, and the contrast of a display improves sharply. Furthermore compared with the acid-resisting method by multilayers, manufacture also has the easy advantage.

[0004] However, it was absorbed when the transmission light by the light guide plate carried out incidence to the polarizer of a circular polarization of light plate, and optical reinforcement declined, and there was a trouble which outgoing radiation effectiveness falls and causes a brightness fall. That is, in lighting mode, brightness fell greatly and there was a trouble that the fall of brightness was large and the variation in light and darkness was large as the light source to ******.

[0005]

[The technical technical problem of invention] Also when the acid-resisting layer which consists of a circular polarization of light plate is formed, this invention controls the fall and variation of brightness in lighting mode, and makes a technical problem development of the light guide plate which can form the front light-type reflective mold liquid crystal display which is excellent in visibility, such as contrast and brightness, and plane-of-polarization light equipment.

[0006]

[Means for Solving the Problem] This invention on the inferior surface of tongue of the plate which carries out outgoing radiation of the incident light from an incidence side face from an inferior surface of tongue through the light emission gunner stage formed in the top face A refractive index is [0.07 or more] lower than the plate, and the clear layer of another object is minded with an adhesives layer. The light guide plate characterized by coming to arrange the optical sheet which possesses a polarizer at least, And the plane-of-polarization light equipment characterized by coming to arrange the light source on 1 or two or more incidence side faces in the light guide plate and a list are provided with the reflective mold liquid crystal display characterized by coming to arrange the liquid crystal cell which has a reflecting layer in the optical outgoing radiation side of the plane-of-polarization light equipment.

[0007]

[Effect of the Invention] Also when the acid-resisting layer which consists of a circular polarization of light plate is formed according to this invention, the fall and variation of brightness in lighting mode can be controlled, and the light guide plate and plane-of-polarization light equipment which can form the front light-type reflective mold liquid crystal display which is excellent in visibility, such as contrast and brightness, can be obtained. It is because this studied the trouble by the conventional method and prepared the clear layer of a low refractive index in the light guide plate rather than the plate.

[0008] That is, by the former, it was advantageous to improvement in brightness to have controlled the reflection in the interface of a plate and an optical sheet, therefore it was thought that it was advantageous to improvement in brightness, so that the refractive index pasted up the plate and the optical sheet by the near glue line as much as possible and the refractive-index difference in a field side was made small. However, as described above in that case, as for the light which becomes easy to carry out incidence to the polarizer with which the light which carried out incidence, and its transmission light penetrate a glue line by the fall of an interface refractive-index difference, and form an optical sheet from the side face of a plate and which carried out incidence to the polarizer, the abbreviation one half is absorbed usually. Therefore, the

light back transmitted by the absorption loss decreases greatly.

[0009] On the other hand, total reflection of the light which carried out incidence from the side face of a plate according to this invention, or its transmission light is carried out with a refractive-index difference with a low refractive-index clear layer, they are easy to be shut up in a plate, and the transmission efficiency of the total reflection of the light to back improves while being hard coming to carry out incidence to a polarizer, in order to tend to receive the light to which the incident angle to a low refractive-index clear layer is large, and easy to be transmitted back. Consequently, the plane-of-polarization light equipment for front light systems which brightness improves, and the variation in brightness also falls, and whose homogeneity of the brightness in a light guide plate outgoing radiation side improves, is excellent in the use effectiveness of light by that cause, and is excellent in brightness and its homogeneity is obtained.

[0010] therefore, by addition of a quarter-wave length plate etc., when it is made to function as an acid-resisting layer which consists of a circular polarization of light plate, an optical sheet It is reflected without the outdoor daylight which carried out incidence from the top face carrying out incidence to a liquid crystal cell etc. on the light guide plate inferior surface of tongue, and the leakage light from a top face and the becoming light can be controlled. There is little leakage light concerned which overlaps the display light from a liquid crystal cell, and becomes generating of white dotage and the cause of a contrast fall when it checks by looking from a top face. The front light-type reflective mold liquid crystal display which is excellent in contrast or brightness in lighting and outdoor daylight mode, and is excellent in display grace can be obtained.

[0011] In the above, the reflection factor under a light guide plate has the large effect which it has on white dotage of a display image or contrast, if about 3 - 5% is predicted by light guide plate outgoing radiation light or outdoor daylight incident light and the reflected light is not controlled in an acid-resisting layer in that case.

[0012]

[Embodiment of the Invention] The light guide plate by this invention comes to arrange the optical sheet with which a refractive index is [0.07 or more] lower than the plate with a sheet, and an adhesives layer possesses a polarizer at least through the clear layer of another object on the inferior surface of tongue of the plate which carries out outgoing radiation of the incident light from an incidence side face from an inferior surface of tongue through the light emission gunner stage formed in the top face. The example was shown in drawing 1 and drawing 2 . The clear layer of a low refractive index and 1C are optical sheets, and the light emission gunner stage and 1B which A formed [1] in the top face with the plate are formed as an acid-resisting layer by the example of drawing.

[0013] The proper thing which carries out outgoing radiation of the incident light from an incidence side face from an inferior surface of tongue through the light emission gunner stage formed in the top face as a plate can be used. The plate of the gestalt which generally has a top face, the inferior surface of tongue which counters it, and the incidence side face which consists of a vertical face-to-face side face like drawing 1 and the example of 2 is used.

[0014] Like the example of drawing, a plate may be the thing of a same thickness mold and may have the gestalt of the wedge which made thinner than that of an incidence side face thickness of the opposite edge which counters an incidence side face. Thin-shape-izing of an opposite edge is more advantageous than points, such as improvement in the incidence effectiveness to the light emission gunner stage formed in the top face of the incident light from lightweight-izing or an incidence side face thru/or its transmission light.

[0015] The light emission gunner stage formed in the top face of a plate can be formed in the proper thing which shows the above-mentioned outgoing radiation property. Directivity improves the incident light from an incidence side face efficiently outgoing radiation from an inferior

surface of tongue through a light emission gunner stage on top. and the point of making the incident light from an inferior surface of tongue penetrating more efficiently without dispersion than a top face -- above all When the light which carried out incidence from the incidence side face thru/or its transmission light carry out outgoing radiation from an inferior surface of tongue, what has the direction theta which shows the maximum reinforcement K of the outgoing radiation light in less than 30 degrees to the normal H to a base plane at the bottom is more desirable than points, such as right visibility in a transverse plane thru/or its direction of near.

[0016] Moreover, in the above, 1/5 or less thing of said maximum reinforcement [in / in the maximum reinforcement of the leakage light from a top face / in / to the aforementioned normal H / the direction of less than 30 degrees / an inferior surface of tongue] K is more desirable than the point of preventing the fall of the contrast by duplication in the leakage light from a top face, and the display image by the outgoing radiation light from an inferior surface of tongue. The leakage light from the top face of said direction tends to overlap the reflected light through the reflecting layer of the outgoing radiation light from the inferior surface of tongue which shows the maximum reinforcement K, if the maximum intensity ratio of the aforementioned top-face leakage light / inferior-surface-of-tongue outgoing radiation light is large, will tend to reduce the strength of a display image relatively, and will be easy to reduce contrast.

[0017] A plate still more desirable than points, such as improvement in display grace, such as brightness at the time of considering as a reflective mold liquid crystal display and contrast, has less than 25 above theta within especially 20 degrees above all less than 28 degrees in the vertical plane over an incidence side face and both base planes at the bottom. Moreover, when an incidence side-face side is made into the negative direction on the basis of the aforementioned normal H, leakage luminous-intensity L from the top face of the same include angle theta as the direction of the maximum reinforcement K is [the maximum reinforcement K concerned] 1/20 or less especially 1/15 or less above all 1/10 or less. Since the leakage light concerned overlaps the direction of specular reflection of the light which shows the maximum reinforcement K, if its value of said L/K is large, it will reduce the strength of a display image relatively and will reduce contrast.

[0018] A light emission gunner stage more desirable than the point of attaining the above-mentioned properties, such as the direction of maximum on-the-strength K, and maximum on-the-strength K / leakage light on-the-strength L ratio, etc. The light emission gunner stage A where drawing 1 , the light emission gunner stage A which has the optical-path conversion slant face A1 which meets an incidence side face (drawing 3 , arrangement side face of the light source 2 of 4) like the example of 2, and the tilt angle to a base plane at the bottom consist of plurality of the crevice or heights possessing the optical-path conversion slant face A1 which is 35 - 48 degrees above all is desirable.

[0019] An aforementioned crevice or heights can be formed in proper gestalten, such as a thing of a triangle or a square, based on the cross section, and can be formed also in the crevice and heights which consist of equilateral sides, such as an isosceles triangle. In addition, the cross section means the cross section of the direction which intersects perpendicularly in the direction of a long side of a light emission gunner stage. Moreover, the aforementioned polygon is not strict and include-angle change of a field, the radius of circle of an intersection, etc. are permitted.

[0020] The structure of a crevice or heights more desirable than the point to which make it reversed by the reflecting layer and directivity is made to improve outgoing radiation light from the use effectiveness and the above mentioned inferior surface of tongue of light outgoing radiation in the direction of a transverse plane (perpendicular) from a top face It is the adjacency structure of the prism-like irregularity of the cross-section triangle which consists of an optical-path conversion slant face A1 as for which the tilt angle theta 1 to a base plane at the

bottom like the example of drawing 1 carries out a declivity to the opposite edge side from an incidence side-face side at 35 - 48 degrees, and a gentle slope A2 whose tilt angle theta 2 concerned is 0 - 10 degrees.

[0021] Moreover, like the example of drawing 2 , it is desirable like [the structure of the crevice or heights of a cross-section triangle which the tilt angle theta 3 to the above mentioned optical-path conversion slant face A1 and a base plane at the bottom becomes from steep incline A3 of 60 degrees or more setting spacing, being distributed, and having flat side 1a based on the top face of a plate 1 whose tilt angle to a base plane at the bottom is 0 - 10 degrees between the crevice over which it is distributed, or heights] the above.

[0022] In addition, an aforementioned crevice or heights has projected whether it has become depressed in the groove from the top face (concave), or (convex) depends it. The light emission gunner stage by slot structure is more desirable than the point of making it hard to get damaged the optical-path conversion slant face A1, and aiming at improvement in endurance, like the example of drawing.

[0023] The optical-path conversion slant face A1 in the crevice or heights which forms a light emission gunner stage carries out the role which reflects in the field the light which carries out incidence among the incident light from an incidence side face, and is supplied to an inferior surface of tongue. In that case, by making the tilt angle theta 1 into 35 - 48 degrees, the direction of the maximum reinforcement K which reflected with sufficient perpendicularity and described above incident light thru/or its transmission light to the inferior surface of tongue can obtain the inferior-surface-of-tongue outgoing radiation light of less than 30 degrees to Normal H, can obtain efficiently the outgoing radiation light (illumination light) which is excellent in the directivity to a transverse plane through the reflecting layer in a liquid crystal display panel, and can attain a bright display.

[0024] The total reflection conditions based on refraction by the Snell's law of light with which the tilt angle theta 1 with an optical-path conversion slant face more desirable than points to a transverse plane, such as directivity, is transmitted in the interior of a plate are 40-44 above all 38 to 45 degrees in consideration of being **41.8 degrees etc. in a refractive index 1.5.

[0025] In addition, although outgoing radiation of a part of light which penetrates an optical path conversion slant face, without satisfy total reflection conditions, and turns into leakage light from a top face is carry out at the large include angle of 60 degrees or more to the direction of a transverse plane and they cannot influence the check by looking near the direction of a transverse plane easily, if the tilt angle theta 1 exceeds 48 degrees, the leakage light from a top face will become easy to increase, and they will become disadvantageous in respect of efficiency for light utilization.

[0026] While reflecting the transmission light which, on the other hand, carries out incidence of flat side 1a between the optical-path conversion slant faces A1, or the gentle slope A2 to it and supplying an optical-path conversion slant face, incidence of the outdoor daylight in reversing the reflected light by the optical-path conversion slant face through the reflecting layer in a liquid crystal display panel, and making it penetrate from a top face and outdoor-daylight mode is carried out, it is reflected through a reflecting layer, and it aims at making it penetrate from a top face. As for the include angle of flat side 1a to a base plane at the bottom, or the tilt angle theta 2 of a gentle slope A2, it is more desirable than this point that it is 0 - 10 degrees.

[0027] Although the include angle of a flat side or the tilt angle of a gentle slope may be 0 times (horizontal plane), in case it reflects in a gentle slope etc. the transmission light which carried out incidence by super-**(ing) 0 times and supplies it to an optical-path conversion slant face, it can carry out parallel Guanghua of the transmission light, it can raise the directivity of the reflected light through an optical-path conversion slant face, and becomes advantageous to a display.

[0028] On the other hand, if the include angle of a flat side or the tilt angle of a gentle slope exceeds 10 degrees, the rate of incidence to a gentle slope etc. falls, the optical supply to opposite one end is insufficient, and it ununiformity-becomes easy toize luminescence, and optical-path modification by refraction will also become large, and the quantity of light of the direction of a transverse plane will fall, and it will become disadvantageous for a display. Moreover, also in the cross-section configuration of a plate, thin shape-ization of opposite one end becomes difficult, the amount of incident light to a light emission gunner stage also decreases, and it becomes easy for luminous efficiency to fall.

[0029] transmission light is parallel -- the tilt angle with a gentle slope more desirable than points, such as said engine performance, such as condensing-izing of the outgoing radiation light by Guanghua, an increment in the quantity of light of the direction of a transverse plane, and control of leakage light, etc. is 5 or less times above all 8 or less times. Like the above, by adjusting the tilt angle concerned of an optical-path conversion slant face, a flat side, or a gentle slope, directivity can be given to outgoing radiation light and it becomes possible to carry out outgoing radiation of the light at a perpendicular direction thru/or the include angle near it to an inferior surface of tongue by that cause.

[0030] A gentle slope more desirable than points, such as the visibility of the display light through the gentle slope concerned on the top face of a plate, is the whole plate, therefore is the difference of the maximum of a tilt angle, and the minimum value, makes angular difference of the tilt angle theta 2 above all especially less than 3 times less than 4 times less than 5 times, and makes the difference of the tilt angle theta 2 between nearby gentle slopes above all especially less than 0.1 degrees less than 0.3 degrees less than 1 time. The effect display light is influenced by this by difference of the tilt angle theta 2 of the gentle slope to penetrate etc. can be controlled. If the deviation of the transparency include angle by the gentle slope is greatly different with a location, it will become an unnatural display light, especially if the deviation difference of a transmission image [/ near the contiguity pixel] is large, it will be easy to become a remarkable unnatural display light.

[0031] Angular difference of the above mentioned tilt angle theta 2 is premised on being in 10 or less degrees which the tilt angle of a gentle slope described above. Namely, this aims at not changing the optimal check-by-looking direction of the liquid crystal display which set up and optimized the viewpoint near the perpendicular direction on the assumption that the deviation of the display light by the refraction at the time of gentle slope transparency is controlled as this small tilt angle theta 2 and it considers as the inside of an allowed value.

[0032] If display light is deflected, while the optimal check-by-looking direction will shift near the perpendicular direction, if the deviation of display light is large, it will approach in the direction of outgoing radiation of the leakage light from a light guide plate top face, and will become [the] easy to be influenced, such as a fall of contrast. In addition, considering as the thing of extent which can also disregard the effect of distribution of the transmitted light etc. is included in the conditions which make the tilt angle theta 2 of a gentle slope etc. 10 or less degrees.

[0033] Moreover, what is excellent in the incidence effectiveness of outdoor daylight, and is excellent in the rate of the transmitted light thru/or outgoing radiation effectiveness of display light by the liquid crystal cell is more desirable than the point of obtaining a bright display light. The thing of that of an optical-path conversion slant face which the projected area of the flat side over a base plane at the bottom thru/or a gentle slope considers as the light emission gunner stage of 15 times or more (a crevice or heights) especially 10 or more times above all 5 or more times is more desirable than this point. Thereby, the great portion of display light by the liquid crystal cell can be made to penetrate through a flat side thru/or a gentle slope.

[0034] In addition, the display light which carried out incidence to the optical-path conversion

slant face on the occasion of transparency of the display light by the liquid crystal cell is deflected in the greatly different direction of anti-one end, carries out outgoing radiation to the display light which was reflected in the incidence side-face side, and did not carry out outgoing radiation from a top face, or penetrated the gentle slope etc. on the basis of the normal to an inferior surface of tongue, and hardly affects the display light through a gentle slope etc.

[0035] Therefore, it is desirable to make small area to which a pixel and an optical-path conversion slant face overlap to become a display insufficient [transparency of display light] and unnatural from the point to prevent, and to secure sufficient light transmittance through a gentle slope etc. Generally, when an example is taken [that it is 100-300 micrometers and], as for an optical-path conversion slant face, it is [the pixel pitch of a liquid crystal cell] more desirable than the aforementioned point to be formed so that it may be set to 40 micrometers or less based on the projection width of face to a base plane at the bottom. It is made hard to be conspicuous in an optical-path conversion slant face, and this projection width of face is effective also in improvement in the visibility of a liquid crystal display. In addition, projection width of face means the shorter side lay length in projection of an optical-path conversion slant face.

[0036] The radius of circle which an advanced technique is needed for the formation on the other hand, so that the projection width of face of an optical-path conversion slant face becomes small, and the crowning of a crevice or heights becomes from the radius of curvature more than fixed suddenly Generally the coherent length of fluorescence tubing from the point set to about 20 micrometers that a scattering effect shows up and it is easy to become the cause of turbulence of display light 1-20 micrometers of projection width of face of an optical-path conversion slant face especially more desirable than it will be easy to become the cause of a fall of the display grace by diffraction etc. if the projection width of face of an optical-path conversion slant face becomes small are 5-15 micrometers above all.

[0037] In addition, it is more desirable than the point of control of dispersion by the radius of circle in the intersection of the field of the optical-path conversion slant face which forms the above mentioned light emission gunner stage thru/or the above mentioned top face, a gentle slope, a steep incline, a flat side, etc. that the sum of the radius of curvature of the radius of circle is [of the depth of a light emission gunner stage or height] 1/6 or less above all 1/4 or less. According to this, the specular reflection in a light emission gunner stage can also fall, and the visibility can also be reduced.

[0038] Although the large thing of spacing of an optical-path conversion slant face is more desirable than the aforementioned point, since it is the substantial outgoing radiation functional division of side-face incident light in one side as the optical-path conversion slant face was described above, if the spacing is too large, the lighting at the time of lighting may serve as a non-dense, and may serve as a too unnatural display.

[0039] Therefore, when an example is taken in the above, it is desirable like drawing 1 and the example of 2 the pitch P of a light emission gunner stage (a crevice or heights) and to set especially the pitch P in the case of the adjacency structure like drawing 1 to 50 micrometers - 1.5mm. In addition, a pitch may be fixed and may be irregular like what combined the pitch unit of a random pitch or a predetermined number at random or regularly, for example. It is made hard to be conspicuous in a light emission gunner stage, especially its optical-path conversion slant face, and it is effective also in improvement in the visibility of a liquid crystal display, and this pitch is so advantageous that it makes a pitch smaller than this point.

[0040] In the case of the light emission gunner stage which consists of a crevice or heights, it may interfere with the pixel of a liquid crystal cell, and moire may be produced. Although prevention of moire can be performed by pitch accommodation of a crevice or heights, as described above, there may be desirable range in the pitch of a crevice or heights. Therefore, a solution in case moire

arises in the pitch range poses a problem.

[0041] In this invention, the method which forms a crevice or heights in an inclination condition to the base plane of an incidence side face, and prevents moire is desirable so that a crevice or heights may be in a crossover condition to a pixel. In that case, if a tilt angle is too large, a deviation is produced in reflection through an optical-path conversion slant face etc., a big bias occurs in the direction of outgoing radiation light, the anisotropy of the luminescence reinforcement in the direction of optical transmission of a light guide plate will become large, and efficiency for light utilization will also fall and it will tend to cause [of display grace] a fall.

[0042] When it sees from a top-face side, as for the tilt angle of the crevice or heights to the base plane of an incidence side face, it is more desirable than the aforementioned point that it takes 28 or less degrees especially for 25 or less degrees above all 0 to 30 degrees based on the crossover include angle of the normal to an optical-path conversion slant face and the normal to an incidence side face. The resolution of a liquid crystal cell is low, and when not producing moire, or when moire can be disregarded, the direction of a long side of a crevice or heights is so desirable that it is parallel to an incidence side face.

[0043] Like the example of drawing 2 , a more advantageous light emission gunner stage than the point of moire prevention sets spacing, and distributes the crevice or heights of the cross-section triangle which consists of an optical-path conversion slant face A1 and steep incline A3. The distribution may be regular and may be irregular. Irregular distribution is advantageous to moire prevention. Moreover, you may be the distribution which ****** has arranged for the purpose of equalization of brightness more densely than an incidence side face.

[0044] Furthermore, since it is more desirable than the point of improvement in optical outgoing radiation effectiveness to have met the light source, when arranging a linear light source like a cold cathode tube on an incidence side face, for example, the optical-path conversion slant face of a light emission gunner stage You may be the distribution which has arranged the direction of a long side of an optical-path conversion slant face in parallel as much as possible on the incidence side face, and when the die length of the light source is short, you may be the distribution toward which the direction of a long side made the light source side incline to an incidence side face about an optical-path conversion slant face [/ near the edge of the light source] so that it may be suitable. When the light source is furthermore the point light source like light emitting diode, you may be the distribution arranged in the shape of a pit so that the direction of a long side of an optical-path conversion slant face may meet the point light source.

[0045] The light emission gunner stage which consists of an optical-path conversion slant face and a steep incline is more advantageous than the point carried out that vision is hard to be carried out. In that case, it is desirable to make especially the tilt angle of the steep incline to a base plane at the bottom into 70 - 90 degrees 65 degrees or more above all 60 degrees or more. Moreover, it is [1/5 or less] desirable 1 / 10 - 1/50, and to carry out area occupied on the top face of a light emission gunner stage to especially 1 / 15 - 1/30 above all.

[0046] In the aforementioned case, based on projection of as opposed to the inferior surface of tongue for the magnitude of a light emission gunner stage, the thing of shorter side lay length it considers as ten to 100 times, and 10-500 micrometers of long side lay length are especially set [a thing] to 20-300 micrometers for the long side lay length above all 1mm or less eight to 500 times 5 or more times is more desirable than the point of making the brightness in outdoor daylight mode and lighting mode balancing.

[0047] A plate can be made into a proper gestalt as described above. Also when considering as a wedge etc., the configuration can be determined suitably and can be made into proper field configurations, such as a straight-line side and a curved surface. Moreover, it can consider as proper field gestalten, such as a straight-line side, a refracting interface, and a curve side, about

an optical-path conversion slant face, a gentle slope, etc. which form a light emission gunner stage.

[0048] The crevice or heights which furthermore forms a light emission gunner stage can also be made into an association although configurations etc. differ in addition to a pitch. In addition, like the example of drawing 3 a and b, a crevice or heights may be a series of things which the ridgeline followed, and may be the intermittent things which have predetermined spacing and were arranged in the direction of a ridgeline at discontinuity like drawing 3 c.

[0049] About the configuration of the inferior surface of tongue in a plate, or an incidence side face, there is especially no limitation and it may be determined suitably. Generally it considers as a perpendicular incidence side face to an inferior surface of tongue [that it is smooth and flat] and its inferior surface of tongue as much as possible. About an incidence side face, improvement in the rate of incident light can also be stretched, for example as a configuration according to the periphery of the light sources, such as a curve concave, etc. It can also consider as the incidence side-face structure of having the induction which furthermore intervenes between the light sources etc., and the induction can be made into a proper configuration according to the light source etc. Moreover, although the appearance of a plate has a common rectangle, it is not limited to this.

[0050] A plate can be formed with a proper ingredient organic [which shows it transparency according to the wavelength region of the light source], and inorganic. Incidentally transparence resin, glass, etc. which are represented with acrylic resin, polycarbonate system resin, norbornene system resin and polyolefine system resin, polyester system resin, polyurethane system resin, epoxy system resin, etc., for example are raised in a light region. You may be the combination object of an inorganic material and an organic material. The plate which did not show a birefringence or was formed with the small ingredient of a birefringence is used preferably.

[0051] A plate can be formed also by the cutting method and can be formed by the proper approach. As the manufacture approach more desirable than points, such as mass-production nature How to imprint a ****** configuration under heating in the mold which can form a predetermined configuration for thermoplastics, The approach of filling up the mold which can fabricate the resin made to fluidize through thermoplastics, or the heat and solvent which carried out heating melting in a predetermined configuration, The approach of filling up thru/or casting and carrying out polymerization of liquefied resin and oligomer which can carry out polymerization, the monomer, etc. to the mold which can form a predetermined configuration with heat, ultraviolet rays thru/or a radiation, etc., etc. is raised.

[0052] Moreover, the mold which can be fabricated in a predetermined configuration is filled up with the aforementioned liquefied resin etc., and after fabricating through the mold which applies the aforementioned liquefied resin etc. to the approach of putting a transparence resin plate on it and carrying out polymerization of the packed bed concerned, and a transparence resin plate, and can fabricate the spreading layer in a predetermined configuration, the approach of carrying out polymerization of the shaping layer etc. is raised. After in the aforementioned case replacing with a transparence resin plate and carrying out polymerization using a bright film etc., it can pierce in a predetermined configuration, and can judge by the method with a proper method etc., and the approach of pasting up on a transparence resin plate through adhesives etc. can take the film.

[0053] Therefore, the plate does not need to be formed as a like and may be formed as layered product of components which consist of congener or ingredient of a different kind etc., and according to one sort of ingredients one-single layer material, although the film in which the light emission gunner stage was formed etc. was pasted up on the light guide section (resin plate) which bears the above mentioned transmission of light.

[0054] Size of a light guide plate, magnitude of the light source, etc. by the purpose of use can

determine the thickness of a plate suitably. Especially the general thickness in the case of using for formation of a liquid crystal display etc. is 0.3-3mm 0.1-5mm above all 10mm or less based on the incidence side face. Moreover, the total light transmission of the incident light of the direction of a vertical side, especially the vertical-incidence light from an inferior surface of tongue to a top face is 95% or more 92% or more above all 90% or more, and Hayes of especially a plate more desirable than the point of attaining a bright display etc. is 10% or less of especially thing 15% or less above all 30% or less.

[0055] Like the example of drawing 1 and drawing 2 , a refractive index is [0.07 or more] lower than the plate, and with an adhesives layer, optical sheet 1C which possesses a polarizer at least is arranged through clear layer 1B of another object, and, thereby, a light guide plate is formed in the inferior surface of tongue of a plate 1. This clear layer 1B of a low refractive index aims at obtaining the light guide plate which is excellent in brightness and its homogeneity.

[0056] By namely, the thing for which a layer with a refractive index lower than it is prepared in the inferior surface of tongue of a plate In case the incident light from the light source 2 is transmitted in the interior of a plate 1 in drawing 2 etc. Carry out total reflection of the transmission light through the refractive-index difference of a plate 1 and clear layer 1B, and it shuts up efficiently in a plate. Transmission light is efficiently transmitted to the side-face side (back) of opposite, transmission light is supplied with sufficient uniformity also to the optical-path conversion slant face A1 of the light emission gunner stage A in a location distant from the light source, optical-path conversion is carried out through reflection by the slant face, and it aims at the homogeneous improvement in the brightness in the optical whole outgoing radiation side.

[0057] Moreover, the clear layer of a low refractive index receives attenuation and a birefringence, and thereby, a transmission condition changes partially, the aforementioned transmission light carries out incidence to an optical sheet, and it makes [transmission light decreases or] prevention of ununiformity-izing etc. the purpose. That is, if transmission light carries out incidence to an optical sheet, it will be absorbed with a polarizer and will decrease. Moreover, with the optical sheet which added the phase contrast plate, it is absorbed, when the linearly polarized light through a polarizer turns into elliptically polarized light and carries out re-incidence to a polarizer according to phase contrast with the phase contrast plate, and it decreases.

[0058] Attenuation of said transmission light serves as reduction of the outgoing radiation quantity of light as it is, the illumination light becomes dark, and the display of a liquid crystal display becomes dark. Moreover, the illumination light becomes dark, so that attenuation also becomes large and becomes far from the light source according to a transmission distance, and the homogeneity of brightness falls. Therefore, the aforementioned attenuation etc. is prevented by controlling the incidence to the optical sheet of transmission light through the clear layer of a low refractive index.

[0059] Using the proper ingredient like the low refractive-index dielectric of for example, an inorganic system or an organic system with or more 0.07 refractive index lower than the ingredient which forms a plate especially a fluorine content compound, or silicone system resin, the clear layer of a low refractive index is a method with proper vacuum deposition method, spin coat method, etc., and can be formed as a thing of another object with an adhesives layer, and there is especially no limitation about the ingredient and formation approach. In addition, by the method which forms the clear layer of a low refractive index with adhesives, such as a binder, the adhesion property of adhesives, such as a binder, falls by the low refractive-index-ization, and the adhesion purpose is not attained.

[0060] The refractive-index difference of a low refractive-index clear layer and a plate is so

advantageous that it is large, and it is [0.1 or more] more desirable than points, such as transmission efficiency to the back by the total reflection of transmission light, that it is especially 0.2-0.4 above all. With the refractive-index difference of this extent, the display grace by outdoor daylight mode is hardly influenced. When the refractive-index difference concerned is incidentally 0.1, the reflection factor of the outdoor daylight in the interface is 0.1% or less, and the fall of the brightness by the reflection loss or contrast is very small.

[0061] The clear layer of a low refractive index is usually prepared in a plate directly. In that case, it is so advantageous to dispersion prevention of transmission light that a clear layer is therefore so smooth that the attachment side of the clear layer in a plate, therefore the inferior surface of tongue of a plate are smooth, and desirable, and more desirable than the point of the effect prevention to display light.

[0062] It is so advantageous that the thickness of the clear layer of a low refractive index is thicker than the point of maintenance of the total reflection effectiveness from it fading in the locked-in effect which is an undulatory stain and was described above by the phenomenon when it is too thin. The thickness can be determined more suitably than points, such as the total reflection effectiveness. Generally, it is more desirable than points over the light with a wavelength of 380-780nm, such as the total reflection effectiveness especially as opposed to light with a wavelength [by the side of short wavelength] of 380nm, that it is the thickness more than one wave (380nm) especially more than 1/2 wave (190nm) above all based on the optical path length computed by refractive-index x thickness more than quarter-wave length (95nm), and it is desirable that it is the thickness of 600 morenm or more.

[0063] Like the example of drawing, optical sheet 1C prepared in the inferior surface of tongue of low refractive-index clear layer 1B shall possess polarizer 1C1 at least. It can consider as the light guide plate which carries out outgoing radiation of the polarization by this. As a polarizer, the proper thing which carries out outgoing radiation of the linearly polarized light can be used, and there is especially no limitation.

[0064] Incidentally as an example of a polarizer, polarization films which dichroism matter, such as iodine and dichromatic dye, was made to stick to the hydrophilic high polymer film like a polyvinyl alcohol system film, a partial formal-ized polyvinyl alcohol system film, and an ethylene-vinylacetate copolymer system partial saponification film, and were extended, such as a film and a polyene oriented film like the dehydration processing object of polyvinyl alcohol or the demineralization acid-treatment object of a polyvinyl chloride, are raised.

[0065] Moreover, a polarizer may have transparent-protection-layer 1C2 and 1C2' which are the protection purposes, such as a water resisting property, and become one side or both sides of said polarization film 1C1 from the spreading layer of resin, the lamination layer of a film, etc. like the example of drawing. The polarizer which has the polarization layer which furthermore consists of a liquid crystal polymer or a polymer of liquid crystal content is raised. It is ******** for good better from points, such as a display with a bright polarizer with high permeability.

[0066] An optical sheet may possess phase contrast plate 1C 1C [3 and]4 more than one layer or two-layer in one side of polarizer 1C1 like the example of drawing. What shows proper phase contrast as the phase contrast plate can be used. Therefore, it can also consider as the optical sheet which functions as an acid-resisting layer which consists of a circular polarization of light plate described above using phase contrast plate 1C4 whose phase contrast is 100-150nm like a quarter-wave length plate, for example, the example of drawing. The optical sheet which added the phase contrast plate can skip the process which pastes up a polarizer and a phase contrast plate on a liquid crystal cell separately, and is advantageous to improvement in the assembly effectiveness of a liquid crystal display panel.

[0067] By functioning using the polarizer in the above mentioned optical sheet as an

acid-resisting layer which consists of a circular polarization of light plate, it is not necessary to prepare the acid-resisting layer of another object which consists of a multilayered film etc., reflection of the outdoor daylight and the illumination light which are produced on the inferior surface of tongue of a light guide plate and the front face of a liquid crystal display panel can be controlled, and the contrast fall of a liquid crystal display can be prevented.

[0068] Namely, when the light which carried out outgoing radiation from the inferior surface of tongue of a plate is reflected by the inferior-surface-of-tongue side rather than a light guide plate according to the aforementioned circular polarization of light plate Since the phase of the circular polarization of light is reversed, the reflected light carries out re-incidence to a quarter-wave length plate and it considers as the linearly polarized light, in case it is circular-polarization-of-light-ized and a light guide plate is penetrated, when the linearly polarized light by the polarizer penetrates a quarter-wave length plate, and it is reflected by the inferior-surface-of-tongue side of a light guide plate, In case re-incidence is carried out to a polarizer, it is the linearly polarized light of the direction absorbed by the phase reversal effectiveness, and a polarizer cannot be penetrated, but acid resisting is attained.

[0069] The aforementioned result, the light guide plate of front arrangement can be penetrated in lighting and outdoor daylight mode, it can prevent the light reflected by the inferior-surface-of-tongue side re-penetrating a light guide plate, and carrying out outgoing radiation as a leakage light from a top face, and the fall of the contrast by duplication in display light etc. can be prevented. In addition, as for the optical sheet as a circular polarization of light plate, it is more desirable than the point of the above mentioned transparency prevention of the reflected light to be arranged so that the optical axis of a polarizer and the lagging axis of a quarter-wave length plate may cross 40 to 50 degrees above all 35 to 55 degrees at the include angle which is especially 45 degrees.

[0070] When forming the aforementioned acid-resisting layer, an optical sheet requires a quarter-wave length plate and that phase contrast should have above all 100-200nm of at least one phase contrast plate which is 100-150nm especially. An optical sheet desirable as an acid-resisting layer has phase contrast plate 1C 4 and 1 whose phase contrast is 100-150nm / phase contrast plate 1C3 whose phase contrast is 200-300nm above all 2 wavelength plate one layer or more than two-layer like the example of drawing, respectively. In addition, when forming an acid-resisting layer, this phase contrast plate is arranged like the example of drawing at one side of a polarizer, and the optical sheet is arranged so that a polarizer may be located in a plate side.

[0071] Addition of the 1/2 above mentioned wavelength plate aims at expansion of the wavelength region as a circular polarization of light plate. Namely, the effectiveness of the above-mentioned phase inversion with a quarter-wave length plate is so high that whenever [circular polarization of light-ized] is high. Generally, only with a quarter-wave length plate, wavelength dispersion occurs in the phase contrast, and it does not become the good circular polarization of light in a full wave length region, but can consider as the good circular polarization of light by combining with 1/2 wavelength plate in almost all the light region. As for the arrangement location of 1/2 wavelength plate, it is more desirable than this point like the example of drawing to consider as between polarizer 1C1 and quarter-wave length plate 1C4. In that case, by the method which combines with what shows the wavelength dispersion property that arrange so that it may become the include angle at which the lagging axis of 1/2 wavelength plate differs from the lagging axis of a quarter-wave length plate, or quarter-wave length plates differ, or uses them together, it is stabilized and the wavelength region of phase inversion can be expanded.

[0072] in addition, the time of the optical axis of a polarizer and the optical axis of 1/2 wavelength plate crossing at the include angle of 5 - 25 degrees, and setting the crossed axes angle to theta in

the arrangement from which the aforementioned include angle was made different, -- the optical axis of a quarter-wave length plate -- 2theta+35-2 -- it is desirable from the point of wavelength region expansion of phase inversion to consider as the relation which crosses in [include-angle] 2theta+40-2theta+50 degree above all theta+55 degrees. When using two or more quarter-wave length plates or 1/2 wavelength plates especially, it is more desirable than the point of being able to make large the range of the wavelength which can make the good circular polarization of light, and demonstrating the acid-resisting effectiveness in a larger wavelength region. In addition, using the phase contrast plate which controlled the refractive index of the thickness direction, the angle of visibility in which a liquid crystal display and acid resisting are possible can be made large, or can also be made intentionally narrow.

[0073] What has what has the orientation layer of the oriented film which consists of various kinds of resin, or a liquid crystal polymer as a quarter-wave length plate, 1/2 wavelength plate, or a phase contrast plate proper, the proper thing which consists of an inorganic crystal can be used. The aforementioned oriented film may carry out extension processing by various kinds of methods, such as extension made to carry out molecular orientation also in the thickness direction by the method heat-treated under adhesion of uniaxial stretching by the free end or the fixed end, biaxial stretching, and a heat shrink nature film.

[0074] The optical sheet may have glue line 1C5 for pasting it up on the inferior surface of tongue of a plate 1 through low refractive-index clear layer 1B like the example of drawing. In the case of the optical sheet which functions as the above-mentioned acid-resisting layer, this glue line 1C5 is formed in the polarizer 1C1 side like the example of drawing. The proper thing of light transmission nature can be used as adhesives which form a glue line. Rather than the point of the simple nature of adhesion, the binder represented with acrylic or a rubber system is used preferably.

[0075] The equipment of versatility, such as a plane-of-polarization light equipment [which carries out outgoing radiation in the direction which is excellent in perpendicularity advantageous to a check by looking in the polarization which the incident light from a top face and an inferior surface of tongue penetrated from the inferior surface of tongue or the top face to fitness according to the light guide plate by this invention, and was made parallel with a sufficient precision using it, and is excellent in brightness, using the light from the light source efficiently], and reflective mold liquid crystal display which are excellent in low-power nature it is still brighter and legible, can be formed.

[0076] The plane-of-polarization light equipment 10 which has a light guide plate by this invention in drawing 4 was illustrated. Like the example of drawing, plane-of-polarization light equipment can be formed in the incidence side face of the plate 1 in a light guide plate by arranging the light source 2, and can be preferably used as a front light of a side light mold etc.

[0077] A proper thing can be used as the light source. the array object which, generally (cold, heat), arranged the point light source of the linear light source of a cathode-ray tube etc., light emitting diode, etc., and it a line, in the shape of a field, etc., or the point light source -- the line of regularity or indeterminate spacing -- the light source using the equipment changed into a luminescence condition etc. can use preferably. A cold cathode tube is more desirable than especially points, such as low-power nature and endurance. The light source can be arranged on 1 or two or more incidence side faces of a plate.

[0078] In order to lead the emission light from the light source 2 to the incidence side face of a plate 1 like drawing 4 and the example of 5 on the occasion of formation of plane-of-polarization light equipment if needed, it can also consider as the combination object which has arranged the auxiliary means with the proper lamp reflector 3 which surrounds the light source. Generally as a lamp reflector, a resin sheet, a metallic foil, etc. which attached the high reflection factor metal

thin film are used. When pasting the edge of a plate through adhesives etc. and making a lamp reflector into the maintenance means of the light source, formation of a light emission gunner stage can also be omitted about a part for the jointing.

[0079] As mentioned above, the plane-of-polarization light equipment by this invention is excellent in the use effectiveness of light, the polarization which is bright and is excellent in perpendicularity can be offered, and from large-area-izing etc. being easy, can be preferably applied to various equipments as a front light in a reflective mold liquid crystal display etc., and can obtain the reflective mold liquid crystal display of a low power etc. it is bright and legible.

[0080] The front light-type reflective mold liquid crystal display could be formed from arranging the liquid crystal cell which has a reflecting layer in the inferior-surface-of-tongue side of a light guide plate according to the optical outgoing radiation side of plane-of-polarization light equipment, and showed the example to drawing 5 . 10 is plane-of-polarization light equipment, and it is a liquid crystal display panel possessing the liquid crystal cell in which 20 has a reflecting layer. 201 and 205 are cel substrates, it is the liquid crystal layer by which 203 was ****(ed) between cel substrates, and the reflecting layer of electrode combination of 202, and 204 is a transparent electrode.

[0081] The reflective mold liquid crystal display 100 is formed by assembling suitably component parts, such as a driving gear of accompanying in the liquid crystal cell and it which possess an electrode and generally function as a liquid crystal shutter, a polarizer, a front light, a reflecting layer, and a phase contrast plate for compensation as occasion demands, an optical diffusion layer, etc. In this invention, except for the point using the above-mentioned plane-of-polarization light equipment of polarizer possession, there is especially no limitation and it can be formed according to the former like the example of drawing.

[0082] Therefore, there is especially no limitation about the liquid crystal cell to be used. What is displayed in the circular polarization of light thru/or elliptically-polarized-light mode above all is desirable. In that case, it is more desirable than the point of a bright display not to prepare the polarizer of another object in a liquid crystal display panel. Moreover, since reflection on the light guide plate inferior surface of tongue and reflection in a liquid crystal cell front face can be prevented when an optical sheet is an acid-resisting type, the liquid crystal cell of the type which does not use polarization like macromolecule distributed process input output equipment, for example can also be used preferably. Therefore, as a liquid crystal cell, what has the proper liquid crystal cell of the twist system like TN liquid crystal cell, a STN liquid crystal cell, a perpendicular orientation cel and a HAN cel, and an OCB cel, a non-twisting system, a guest host system, or a ferroelectric liquid crystal system etc. can be used, for example.

[0083] Moreover, there may not be especially limitation about the drive method of the liquid crystal in a liquid crystal cell, either, for example, you may be proper drive methods, such as an active matrix and a passive matrix method. Furthermore, by the thing in a location without the need of making the illumination light and display light penetrating, a cel substrate and an electrode need to be neither a transparence substrate nor a transparent electrode, and can also be formed with the opaque body.

[0084] In a reflective mold liquid crystal display, although arrangement of a reflecting layer is indispensable, about the arrangement location, it can determine suitably, for example, can also prepare in the outside of a liquid crystal cell, and can also prepare in drawing 5 inside a liquid crystal cell like instantiation. What has the latter reflecting layer 202 inside a liquid crystal cell is desirable in respect of generating of parallax.

[0085] A reflecting layer can be formed as a proper reflecting layer according to the former which supported the coating layer which contains the powder of high reflection factor metals, such as aluminum, silver and gold, copper, and chromium, in binder resin, the attachment layer of the

metal thin film by a vacuum evaporationo method etc., and its coating layer and attachment layer with the base material, such as a reflective sheet and a metallic foil.

[0086] In addition, when forming a reflecting layer 202 in the interior of a liquid crystal cell like the example of drawing 5 , the reflecting layer can also be formed as what serves as an electrode with high conductivity ingredients, such as the aforementioned high reflection factor metal, and can also be put side by side with a transparent electrode etc., and can also be formed with a transparent electrode.

[0087] An optical diffusion layer is established if needed for the purpose of equalization of the brightness by prevention of light-and-darkness nonuniformity, reduction of the moire by jumble of a contiguity beam of light, etc. A thing proper also as an optical diffusion layer can be used. What made the spreading hardening layer which distributed the transparence particle of a high refractive index, the spreading hardening layer of the transparence resin which distributed air bubbles, and the base material front face swell through a solvent, and incidentally generated KUREIZU in the transparence resin of a low refractive index as the example, the diffusion sheet which prepared the transparence resin layers which have an irregular crevice or a heights side, or those layers in the support base material are raised.

[0088] An irregular aforementioned crevice or an aforementioned irregular heights side can be formed in the front face of the spreading layer of transparence resin prepared a base material and on it by the method with proper mechanical method which imprints split-face configurations, such as a roll metallurgy mold which carried out the surface roughening process, chemical preparation method, etc. things also with conductive things proper to the aforementioned transparence particle, such as the silica whose mean diameter is 0.5-30 micrometers, an alumina, a titania, a zirconia, tin oxide, indium oxide, cadmium oxide, and antimony oxide, such as organic system particles, such as a certain inorganic system particle, and bridge formation or non-crosslinked polymer, -- one sort -- or two or more sorts can be used.

[0089] In addition, an optical diffusion layer can be established also to the optical sheet of a light guide plate, and can be arranged one layer or more than two-layer in the proper location of a liquid crystal display. Moreover, what shows diffusing power with weak extent which does not disturb display light as an optical diffusion layer is used preferably.

[0090] On the other hand, the above-mentioned phase contrast plate for compensation is usually arranged if needed between a polarizer and a liquid crystal cell for the purpose of compensating the wavelength dependency of a birefringence etc. and raising visibility etc. Therefore, it can also consider as the optical sheet which incorporated this phase contrast plate for compensation. As a phase contrast plate for compensation, a proper thing can be used according to a wavelength region etc., and it may be formed as a superposition layer of the phase contrast layer more than one layer or two-layer.

[0091] A check by looking of the reflective mold liquid crystal display by this invention is performed through the transmitted light of the flat side of the plate thru/or a gentle slope, as, especially being described above. [polarization surface light source] Although the reflecting layer 202 was incidentally formed in the liquid crystal cell of the instantiation to drawing 5 , in a check by looking of a case, in the lighting mode of plane-of-polarization light equipment, the polarization which carried out outgoing radiation from optical sheet 1C under a light guide plate is reflected through a reflecting layer 202 via liquid crystal layer 203 grade, it results in a plate 1 via [a liquid crystal layer, an optical sheet, etc.] reverse, and the display light which penetrated the gentle slope A2 is checked by looking.

[0092] On the other hand, when plane-of-polarization light equipment is in outdoor daylight mode of an astigmatism LGT, the light which carried out incidence from the gentle slope A2 on the top face of a plate, and it results in a plate 1, and can check by looking near the direction of a

transverse plane in the condition of excelling in display grace with little turbulence according [the display light which penetrated the gentle slope] to a plate etc. [via an optical sheet, a liquid crystal layer, etc.] [according to the above] [penetrate and] [reverse] In addition, a proper method can perform lighting and putting out lights of plane-of-polarization light equipment.

[0093] in this invention, laminating unification is carried out on the whole or partially, and components which have formed the above-mentioned light guide plate, plane-of-polarization light equipment, and a liquid crystal display, such as a plate, a polarizer and a phase contrast plate, and a liquid crystal cell, fix -- having -- **** -- separation -- it may be arranged at the easy condition. It is more desirable than points, such as gap prevention of an optical axis, that it is in a fixing condition. Proper transparence adhesives, such as a binder, can be used for the fixing processing, and it can also consider as the glue line which is made to contain the transparence particle described above to the transparence glue line, and shows a diffusion function.

[0094]

[Example] an example 1 -- the front face of the polymethylmethacrylate plate (refractive index 1.495) into which the predetermined configuration was processed beforehand was cut with the diamond tool, and the plate which has a light emission gunner stage was formed in the top face. The plate is 0.8mm in 1.0mm in width of face of 30mm, the depth of 42mm, and thickness of an incidence side face, and thickness of an opposite edge, and its vertical side is flat.

[0095] Moreover, the light emission gunner stage was the cross-section triangle which consists of an optical-path conversion slant face of 41.5 - 43 tilt angles, and a gentle slope of one - two tilt angles, the projection width of face to the inferior surface of tongue of the optical-path conversion slant face which adjoins, has a continuation slot parallel to an incidence side face in the pitch of 210 micrometers (drawing 1 and drawing 3 a), and meets an incidence side face was 6-9 micrometers, and the projected area ratios to the inferior surface of tongue of a gentle slope / optical-path conversion slant face were 20/1 or more things. Moreover, the degree difference of tilt angle between nearby gentle slopes was less than 0.1 degrees. In addition, the light emission gunner stage was formed from the location distant from the incidence side face 2mm.

[0096] Next, vacuum deposition of the magnesium fluoride of a refractive index 1.38 was carried out to 610nm in thickness on the inferior surface of tongue of said plate, the optical sheet was pasted up through the acrylic adhesive layer to the low refractive-index clear layer, and the light guide plate was obtained.

[0097] The aforementioned optical sheet consisted of what carried out the laminating of a polarization film (the NITTO DENKO CORP. make, SEG1426DU), the phase contrast film whose phase contrast is 260nm, and the phase contrast film whose phase contrast is 130nm one by one through the acrylic adhesive layer, and pasted up the polarizer as a plate side.

[0098] In addition, the shaft orientations of each film in an optical sheet make 0 times the incidence side face of a light guide plate based on the time of seeing from the top-face side of a light guide plate, and, for the absorption shaft orientations of a polarizer, the lagging axis of an inside phase contrast film is [the lagging axis of an outside phase contrast film] 86 degrees 28 degrees 15 degrees.

[0099] Subsequently, the incidence side face of said light guide plate was made to carry out heart correspondence of the cold cathode tube (the Harrison electrical-and-electric-equipment company make) with a diameter of 2mm, adhesion arrangement was carried out, and it was surrounded in the lamp reflector which consists of polyester film which gave silver vacuum evaporationo, and the edge was pasted up on the vertical end face of a light guide plate with the pressure sensitive adhesive double coated tape, it fixed, and plane-of-polarization light equipment was obtained. In addition, to the cold cathode tube, using a thing longer enough than incidence side-face length, the core was made to correspond and has been arranged. Moreover, an inverter and DC power

supply are connected to a cold cathode tube, and it enabled it to change lighting/putting out lights by turning on and off of the power source.

[0100] Then, to the optical sheet side of said plane-of-polarization light equipment, in the liquid crystal cell, the liquid crystal display panel of marketing which has a diffusion mold reflecting layer has been arranged, and the reflective mold liquid crystal display was obtained. In addition, the liquid crystal display was the thing of the drive type which makes all pixels turn on / turn off, from the commercial object, it carried out exfoliation removal and the polarizer and phase contrast plate were used for it.

[0101] Thickness of a low refractive-index clear layer it is thin from example 2 magnesium fluoride was set to 320nm, and also a light guide plate, plane-of-polarization light equipment, and a reflective mold liquid crystal display were obtained according to the example 1.

[0102] As an example 3 optical sheet, what carried out the laminating of a polarization film and the phase contrast film of 130nm of phase contrast was used, and also a light guide plate, plane-of-polarization light equipment, and a reflective mold liquid crystal display were obtained according to the example 1. In addition, the shaft orientations of each film in an optical sheet make 0 times the incidence side face of a light guide plate based on the time of seeing from the top-face side of a light guide plate, and the absorption shaft orientations of a polarizer is [the lagging axis of a phase contrast film] 60 degrees 15 degrees.

[0103] The plate which has a light emission gunner stage different example 4 was used, and also a light guide plate, plane-of-polarization light equipment, and a reflective mold liquid crystal display were obtained according to the example 1. In addition, a plate is formed according to an example 1 and it has it in the pitch of 210 micrometers by using as a continuation slot the light emission gunner stage of the cross-section triangle which consists of an optical-path conversion slant face whose tilt angle is about 42 degrees, and a steep incline whose tilt angle is 80 degrees (drawing 3 b). In addition, the projection width of face to the inferior surface of tongue of an optical-path conversion slant face is 6-9 micrometers, and the projected area ratios to the inferior surface of tongue of a flat side (top face) / optical-path conversion slant face are 19/1 or more things.

[0104] an example 5 -- after the refractive index cast the ultraviolet curing mold acrylic resin which forms the hardening layer of 1.51 into the metal mold beforehand formed in the predetermined configuration, the acrylic resin plate of 1mm in thickness and a refractive index 1.495 beforehand cut down in the predetermined configuration was put on it, ultraviolet rays were irradiated from the acrylic resin plate side, ultraviolet-rays hardening resin was stiffened, it removed calmly from metal mold, and the plate was obtained.

[0105] As for the aforementioned plate, ****** distributed more densely over the top face the light emission gunner stage with a die length of about 100 micrometers where width of face consists of an optical-path conversion slant face whose tilt angle is 42 degrees, and a steep incline of about 80 tilt angles by about 9 micrometers from the incidence side face (drawing 3 c). In addition, the surface ratio of the flat side / light emission gunner stage in a top face was 19/1 or more. The plate was used and also a light guide plate, plane-of-polarization light equipment, and a reflective mold liquid crystal display were obtained according to the example 1.

[0106] As an example 6 low refractive-index clear layer, it applied so that the thickness after hardening polysiloxane system coating liquid might be set to 800nm, heated for 30 minutes and it was made to harden at 80 degrees C (refractive index 1.36), and also according to the example 1, a light guide plate, plane-of-polarization light equipment, and a reflective mold liquid crystal display were obtained.

[0107] A low refractive-index clear layer was not prepared in example of comparison 1 plate, and also a light guide plate, plane-of-polarization light equipment, and a reflective mold liquid crystal

display were obtained according to the example 1.

[0108] A low refractive-index clear layer was not prepared in example of comparison 2 plate, and also a light guide plate, plane-of-polarization light equipment, and a reflective mold liquid crystal display were obtained according to the example 3.

[0109] The tilt angle of an example of comparison 3 optical-path conversion slant face was made into 30 degrees, and also a light guide plate, plane-of-polarization light equipment, and a reflective mold liquid crystal display were obtained according to the example 1.

[0110] The metal mold which carried out surface roughening with example of comparison 4 sandblasting was used, and also a light guide plate, plane-of-polarization light equipment, and a reflective mold liquid crystal display were obtained according to the example 1.

[0111] The plate which does not prepare an example of comparison 5 low refractive-index clear layer was used as a light guide plate, and also plane-of-polarization light equipment and a reflective mold liquid crystal display were obtained according to the example 1. However, since a light guide plate did not have an optical sheet, the liquid crystal display panel was used, without exfoliating the polarizer and phase contrast plate.

[0112] The refractive index pasted up the fluorine content adhesive layer of 1.42 for the optical sheet on the plate inferior surface of tongue, without preparing a low refractive-index clear layer in example of comparison 6 plate, and also a light guide plate, plane-of-polarization light equipment, and a reflective mold liquid crystal display were obtained according to the example 1.

[0113] In the reflective mold liquid crystal display of the confession voice acquired in the evaluation trial example and the example of a comparison While turning on plane-of-polarization light equipment all over a dark room, considering as lighting mode and a luminance meter's (the TOPCON CORP. make's, BM-7) investigating the transverse-plane brightness in respect of [in the location of 10mm, 20mm and 30mm] a check by looking from the incidence side face in the core of the cross direction of a light guide plate The contrast ratio was computed by having investigated the transverse-plane brightness in the 20mm location concerned at the time of carrying out visual observation of the visibility, and considering as a black display.

[0114] The aforementioned result was shown in the following table.

Transverse-plane brightness (cd/m2) Contra White ** Voice Black condition Strike ratio Location 10mm 20mm 30mm 20mm 20mm Example 1 124 128 121 10 12.8 Example 2 120 116 110 9 12.9 Example 3 110 117 119 12 9.8 Example 4 131 127122 9 14.1 Example 5 118 121 127 1111.0 Example 6 120 133139 11 12.1 Example 1 of a comparison 121 92 69 10 9.2 Example 2 of a comparison 115 75 499 8.3 Example 3 of a comparison 4251 55 11 4.6 Example 4 of a comparison 16 22 29 16 Example 5 of 1.4 comparisons 148 153 159 24 6.4 Example 6 of a comparison 114 99 83 11 9.0 [0115] In a table, in the example, brightness is high and the variation also shows excelling in homogeneity few from contrast of an example 1, the example 1 of a comparison and an example 3, and the example 2 of a comparison. Moreover, an example is high also in respect of a contrast ratio, and it turns out that it excels in the effectiveness by having prepared the low refractive-index clear layer. In the example of a comparison, from the incidence side face, brightness was falling [******] greatly and the effect by absorption of a polarizer was suggested.

[0116] Still more sufficient brightness in the direction of a transverse plane in the examples 3 and 4 of a comparison was not obtained, but it was the brightest in the direction of slant. In the example 4 of a comparison, the optical outgoing radiation from the top face of a light guide plate is especially large, and it was white dotage ******. This shows that good optical outgoing radiation cannot be attained in configurations other than the light emission gunner stage by this invention. Moreover, in the example 5 of a comparison, although one or more-example brightness was obtained, the contrast ratio was also falling greatly at white dotage ****** compared with the example by surface reflection on a light guide plate inferior surface of tongue and the liquid

crystal cell top face.

[0117] On the other hand, in the contrast ratio, the brightness in a black condition was high in the examples 4 and 5 of a comparison, and it turned out [of the contrast ratio] that it is small compared with the example. Also for viewing, the examples 4 and 5 of a comparison are white dotage ********. In the example 4 of a comparison, direct light especially carried out outgoing radiation from the light guide plate, and itself had shone. Moreover, in the example 5 of a comparison, it turned out that it was reflected before the illumination light carried out incidence to the liquid crystal panel by the reflection from a light guide plate inferior surface of tongue and a liquid crystal panel top face, and the fall of a contrast ratio is caused. Furthermore in the example 6 of a comparison, it was inferior also in respect of the contrast ratio a little compared with the example 1.

[0118] Next, the lighting of a dark room was made to turn on and visual observation of the liquid crystal panel was carried out in the state of putting out lights as a white display and a black display. Consequently, in the example 5 of a comparison, the display ******** [white-dotage-] to the black display having been in sight distinctly in an example and especially the examples 1, 2, 3, and 6 of a comparison and was hard to see by reflection of the inferior surface of tongue of a light guide plate, and reflection in a liquid crystal panel front face. Moreover, compared with other examples, reflected [the light source or a perimeter] was greatly hard to see. the scatter reflection furthermore according to the split face on the top face of a light guide plate at the example 4 of a comparison -- light -- reflecting irregularly -- a display -- white dotage ** -- it was hard to see. Moreover, the example 6 of a comparison was not enough as the adhesive strength of a binder, and a polarizer tends to separate and it was hard to use it.

[0119] It turns out that the chlorofluocarbon try type reflective mold liquid crystal display of the good display grace which is bright and excels the above in the homogeneity in lighting and outdoor daylight mode in the example is realized.

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					６０１Ｃ	２Ｈ０９１
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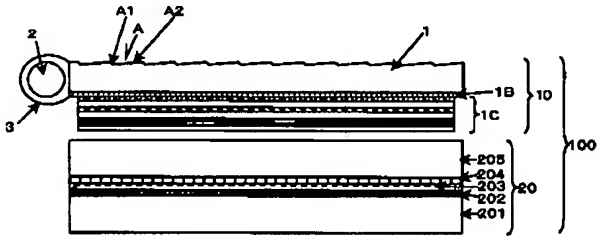
(54)【発明の名称】　導光板、偏光面光源装置及び反射型液晶表示装置

(57)【要約】
【課題】　円偏光板からなる反射防止層を形成した場合にも、点灯モードにおける輝度の低下やバラツキを抑制して、コントラストや明るさ等の視認性に優れるフロントライト式の反射型液晶表示装置を形成しうる導光板や偏光面光源装置の開発
【解決手段】　入射側面からの入射光を上面に形成した光出射手段（Ａ）を介して下面より出射する板状体（１）の下面に、その板状体よりも屈折率が０．０７以上低く、かつ接着剤層とは別体の透明層（１Ｂ）を介し、少なくとも偏光子（１Ｃ１）を具備する光学シート（１Ｃ）を配置してなる導光板、その導光板における１又は２以上の入射側面に光源（２）を配置してなる偏光面光源装置（１０）及びその偏光面光源装置の光出射側に、反射層（２０２）を有する液晶セル（２０）を配置してなる反射型液晶表示装置（１００）。



【特許請求の範囲】
【請求項１】　入射側面からの入射光を上面に形成した光出射手段を介して下面より出射する板状体の下面に、その板状体よりも屈折率が０．０７以上低く、かつ接着剤層とは別体の透明層を介し、少なくとも偏光子を具備する光学シートを配置してなることを特徴とする導光板。
【請求項２】　請求項１において、板状体上面の光出射手段がその横断面に基づいて三角形又は四角形の凹部又は凸部の複数からなる導光板。
【請求項３】　請求項１又は２において、板状体上面の光出射手段が下面の基準平面に対する傾斜角３５～４８度の光路変換斜面を具備する導光板。
【請求項４】　請求項３において、光出射手段の光路変換斜面が入射側面と対面する導光板。
【請求項５】　請求項３又は４において、光出射手段が光路変換斜面と緩斜面からなる横断面三角形の凹部又は凸部が５０μm～１．５mmピッチで隣接した構造からなり、下面の基準平面に対する前記緩斜面の傾斜角が１０度以下で、その全体の角度差が５度以内であり、かつ最寄りの緩斜面における当該傾斜角の差が１度以内であると共に、下面の基準平面に対する緩斜面の投影面積が光路変換斜面のそれの５倍以上である導光板。
【請求項６】　請求項３又は４において、光出射手段が光路変換斜面と急斜面からなる横断面三角形の凹部又は凸部が間隔をおいて分布した構造からなり、前記の急斜面が下面の基準平面に対し６０度以上の傾斜角を有し、かつ光出射手段の上面に占める面積が１／５以下である導光板。
【請求項７】　請求項６において、光出射手段が凹部からなる導光板。
【請求項８】　請求項３～７において、光路変換斜面の下面に対する投影に基づいてその短辺方向の長さが４０μm以下である導光板。
【請求項９】　請求項５～８において、上面側から見たときに光路変換斜面に対する法線と入射側面に対する法線との交差角度が０～３０度である導光板。
【請求項１０】　請求項６～９において、光出射手段の下面に対する投影に基づいてその長辺方向の長さが、短辺方向の長さの５倍以上である導光板。
【請求項１１】　請求項１０において、光出射手段の下面に対する投影に基づいてその長辺方向の長さが１mm以下である導光板。
【請求項１２】　請求項６～１１において、光出射手段の上面における分布が不規則である導光板。
【請求項１３】　請求項１～１２において、光学シートが１層又は２層以上の位相差板を偏光子の片側に具備し、その偏光子が板状体側に位置する導光板。
【請求項１４】　請求項１３において、光学シートが位相差１００～１５０nmの位相差板を１層又は２層以上具備する導光板。
【請求項１５】　請求項１３において、光学シートが２層以上の位相差板を具備し、その位相差板の位相差が１００～１５０nm又は２００～３００nmである導光板。
【請求項１６】　請求項１～１５に記載の導光板における１又は２以上の入射側面に光源を配置してなることを特徴とする偏光面光源装置。
【請求項１７】　請求項１６に記載の偏光面光源装置の光出射側に、反射層を有する液晶セルを配置してなることを特徴とする反射型液晶表示装置。
【発明の詳細な説明】
【０００１】
【発明の技術分野】本発明は、光の利用効率に優れて明るくて見易い反射型液晶表示装置を形成しうる導光板及びそれを用いた偏光面光源装置に関する。
【０００２】
【発明の背景】暗部等での視認を可能とするサイドライト型導光板よりなる面光源装置を視認側に有するフロントライト式の反射型液晶表示装置が知られていた（特開平１２－１１１９００号公報）。フロントライト式では導光板を通して表示光を視認することとなるため、その導光板には、視認側に漏れ光を出射しないこと、下面側からの出射光が法線方向の指向性に優れること、視認時に上面からの透過光を散乱させずに表示像を乱さないこと、光の利用効率が高くて輝度に優れることなどの特性が要求される。
【０００３】また反射型液晶表示装置においては、導光板による外光反射、特に下面での反射が液晶セル面での正反射と重なり、特に外光モードでの表示品位を低下させやすい。そのため斯かる反射防止を目的に円偏光板等が配置される。これは、円偏光板を介した円偏光を反射面で反転させてその反射光を吸収させるものである。円偏光板としては通例、偏光子と１／４波長板の積層体が用いられ、これによれば偏光子を導光板側に位置させることで反射防止と共に、表示用の偏光子を兼ねさせることができる。また導光板下面での反射光に限らず、液晶表示装置表面での反射も防止でき、表示のコントラストが大幅に向上する。さらに多層膜による反射防止方式に比べて製造が容易な利点も有している。
【０００４】しかしながら導光板による伝送光が円偏光板の偏光子に入射すると吸収されて光強度が減衰し、出射効率が低下して輝度低下を招く問題点があった。すなわち点灯モードにおいて輝度が大きく低下し、光源から遠離るほど輝度の低下が大きくて明暗のバラツキが大きい問題点があった。
【０００５】
【発明の技術的課題】本発明は、円偏光板からなる反射防止層を形成した場合にも、点灯モードにおける輝度の低下やバラツキを抑制して、コントラストや明るさ等の視認性に優れるフロントライト式の反射型液晶表示装置

を形成しうる導光板や偏光面光源装置の開発を課題とする。

【０００６】

【課題の解決手段】本発明は、入射側面からの入射光を上面に形成した光出射手段を介して下面より出射する板状体の下面に、その板状体よりも屈折率が０．０７以上低く、かつ接着剤層とは別体の透明層を介し、少なくとも偏光子を具備する光学シートを配置してなることを特徴とする導光板、及びその導光板における１又は２以上の入射側面に光源を配置してなることを特徴とする偏光面光源装置、並びにその偏光面光源装置の光出射側に、反射層を有する液晶セルを配置してなることを特徴とする反射型液晶表示装置を提供するものである。

【０００７】

【発明の効果】本発明によれば、円偏光板からなる反射防止層を形成した場合にも、点灯モードにおける輝度の低下やバラツキを抑制して、コントラストや明るさ等の視認性に優れるフロントライト式の反射型液晶表示装置を形成しうる導光板や偏光面光源装置を得ることができる。これは従来方式による問題点を究明して、導光板に板状体よりも低屈折率の透明層を設けたことによる。

【０００８】すなわち従来では、板状体と光学シートの界面における反射を抑制することが輝度の向上に有利であり、従って板状体と光学シートを屈折率が可及的に近い接着層で接着して各界面での屈折率差を小さくするほど輝度の向上に有利であると考えられていた。しかしその場合には上記したように、板状体の側面より入射した光やその伝送光が界面屈折率差の低下で接着層を透過して光学シートを形成する偏光子に入射しやすくなり、偏光子に入射した光は通例その約半分が吸収される。そのためその吸収損失で後方に伝送される光が大きく減少する。

【０００９】一方、本発明によれば板状体の側面より入射した光やその伝送光は、低屈折率透明層との屈折率差で全反射されて板状体内に閉じ込められやすく、またその全反射は低屈折率透明層への入射角が大きくて後方に伝送されやすい光ほど受けやすいため、偏光子に入射しにくくなると共に後方への光の伝送効率が向上する。その結果、輝度が向上し、また輝度のバラツキも低下して導光板出射面での輝度の均一性が向上し、それにより光の利用効率に優れ、明るさとその均一性に優れるフロントライトシステム用の偏光面光源装置が得られる。

【００１０】従って１／４波長板等の付加で光学シートを円偏光板からなる反射防止層として機能するようにした場合には、上面より入射した外光が導光板下面で液晶セル等に入射することなく反射されて上面からの漏れ光となる光を抑制でき、上面から視認した場合に液晶セルからの表示光と重複して白呆けの発生やコントラスト低下の原因となる当該漏れ光が少なくて、点灯・外光両モードにおいてコントラストや明るさに優れて表示品位に優れるフロントライト式の反射型液晶表示装置を得ることができる。

【００１１】前記において、導光板下面での反射率は、導光板出射光又は外光入射光で３～５％程度が予測され、その場合に反射防止層にて反射光を抑制しないと表示像の白呆けやコントラストに与える影響が大きい。

【００１２】

【発明の実施形態】本発明による導光板は、入射側面からの入射光を上面に形成した光出射手段を介して下面より出射する板状体の下面に、その板状体よりも屈折率が０．０７以上低く、かつ接着剤層とは別体の透明層を介し、少なくとも偏光子を具備する光学シートを配置してなるものである。その例を図１、図２に示した。１が板状体で、Ａがその上面に形成した光出射手段、１Ｂが低屈折率の透明層、１Ｃが光学シートであり、図例では反射防止層として形成されている。

【００１３】板状体としては、入射側面からの入射光を上面に形成した光出射手段を介して下面より出射する適宜なものを用いうる。一般には図１、２の例の如く上面、それに対向する下面、及び上下面間の側面からなる入射側面を有する形態の板状体が用いられる。

【００１４】板状体は、図例の如く同厚型のものであってもよいし、入射側面に対向する対向端の厚さを入射側面のそれよりも薄くした楔形等の形態を有するものであってもよい。対向端の薄型化は、軽量化や入射側面からの入射光ないしその伝送光の上面に形成した光出射手段への入射効率の向上などの点より有利である。

【００１５】板状体の上面に形成する光出射手段は、上記した出射特性を示す適宜なものにて形成することができる。入射側面からの入射光を上面の光出射手段を介して下面より指向性よく効率的に出射させ、かつ下面からの入射光を上面より散乱なく効率よく透過させる点、就中、正面ないしその近傍方向での良視認性などの点より、入射側面より入射した光ないしその伝送光が下面より出射した場合にその出射光の最大強度Ｋを示す方向θが下面の基準平面に対する法線Ｈに対して３０度以内にあるものが好ましい。

【００１６】また前記において、上面からの漏れ光と下面からの出射光による表示像との重複によるコントラストの低下を防止する点よりは、前記の法線Ｈに対して３０度以内の方向における上面からの漏れ光の最大強度が下面における前記最大強度Ｋの１／５以下のものが好ましい。前記方向の上面からの漏れ光は、最大強度Ｋを示す下面からの出射光の反射層を介した反射光と重複しやすく、前記の上面漏れ光／下面出射光の最大強度比が大きいと表示像の強さを相対的に減殺しやすく、コントラストを低下させやすい。

【００１７】反射型液晶表示装置とした場合の明るさやコントラスト等の表示品位の向上などの点よりさらに好ましい板状体は、入射側面と下面の両基準平面に対する

垂直面内において前記θが２８度以内、就中２５度以内、特に２０度以内にあるものである。また前記の法線Ｈを基準に入射側面の側を負方向としたとき、最大強度Ｋの方向と同じ角度θの上面からの漏れ光の強度Ｌが当該最大強度Ｋの１／１０以下、就中１／１５以下、特に１／２０以下であるものである。当該漏れ光は、最大強度Ｋを示す光の正反射方向と重複するため前記Ｌ／Ｋの値が大きいと表示像の強さを相対的に減殺しコントラストを低下させる。

【００１８】上記した最大強度Ｋ方向や最大強度Ｋ／漏れ光強度Ｌ比等の特性を達成する点などより好ましい光出射手段は、図１、２の例の如く入射側面（図３、４での光源２の配置側面）と対面する光路変換斜面Ａ１を有する光出射手段Ａ、就中、下面の基準平面に対する傾斜角が３５～４８度の光路変換斜面Ａ１を具備する凹部又は凸部の複数からなる光出射手段Ａが好ましい。

【００１９】前記の凹部又は凸部は、横断面に基づいて三角形や四角形のものなどの適宜な形態に形成でき、二等辺三角形等の等辺面からなる凹部や凸部にても形成することができる。なお横断面は、光出射手段の長辺方向に直交する方向の断面を意味する。また前記の多角形は、厳密なものでなく、面の角度変化や交点の丸みなどは許容される。

【００２０】光の利用効率や前記した下面よりの出射光を反射層で反転させて上面より正面（垂直）方向に指向性よく出射させる点などより好ましい凹部又は凸部の構造は、図１の例の如き、下面の基準平面に対する傾斜角θ１が３５～４８度で、入射側面の側よりその対向端の側に下り傾斜する光路変換斜面Ａ１と当該傾斜角θ２が０～１０度の緩斜面Ａ２からなる横断面三角形のプリズム状凹凸の隣接構造である。

【００２１】また図２の例の如く、前記した光路変換斜面Ａ１と、下面の基準平面に対する傾斜角θ３が６０度以上の急斜面Ａ３からなる横断面三角形の凹部又は凸部が間隔をおいて分布し、その分布する凹部又は凸部間に板状体１の上面に基づく、下面の基準平面に対する傾斜角が０～１０度の平坦面１ａを有する構造も前記と同様に好ましい。

【００２２】なお前記の凹部又は凸部は、上面より溝状に窪んでいるか（凹）、突出しているか（凸）による。光路変換斜面Ａ１を傷付き難くして耐久性の向上を図る点よりは、図例の如く溝構造による光出射手段が好ましい。

【００２３】光出射手段を形成する凹部又は凸部における光路変換斜面Ａ１は、入射側面よりの入射光の内、その面に入射する光を反射して下面に供給する役割をする。その場合、その傾斜角θ１を３５～４８度とすることにより、入射光ないしその伝送光を下面に対し垂直性よく反射し、上記した最大強度Ｋの方向が法線Ｈに対し３０度以内の下面出射光を得て、液晶表示パネルにおける反射層を介し正面への指向性に優れる出射光（照明光）を効率よく得ることができ、明るい表示を達成することができる。

【００２４】正面への指向性等の点より光路変換斜面の好ましい傾斜角θ１は、板状体内部を伝送される光のスネルの法則による屈折に基づく全反射条件が例えば屈折率１．５では±４１．８度であることなどを考慮して、３８～４５度、就中４０～４４である。

【００２５】なお全反射条件を満足せずに光路変換斜面を透過して、上面からの漏れ光となる一部の光は、正面方向に対し６０度以上の大きい角度で出射して正面方向近傍の視認に影響しにくいが、傾斜角θ１が４８度を超えると上面よりの漏れ光が増大しやすくなり光利用効率の点で不利となる。

【００２６】一方、光路変換斜面Ａ１間の平坦面１ａや緩斜面Ａ２は、それに入射する伝送光を反射して光路変換斜面に供給すると共に、光路変換斜面による反射光を液晶表示パネルにおける反射層を介し反転させて上面より透過させること、及び外光モードでの外光を入射させてそれを反射層を介し反射させ、上面より透過させることを目的とする。斯かる点より、下面の基準平面に対する平坦面１ａの角度又は緩斜面Ａ２の傾斜角θ２は、０～１０度であることが好ましい。

【００２７】平坦面の角度又は緩斜面の傾斜角は、０度（水平面）であってもよいが、０度超とすることで緩斜面等に入射した伝送光を反射して光路変換斜面に供給する際に伝送光を平行光化することができ、光路変換斜面を介した反射光の指向性を高めることができて、表示に有利となる。

【００２８】一方、平坦面の角度又は緩斜面の傾斜角が１０度を超えると、緩斜面等への入射率が低下し対向端側への光供給が不足して発光が不均一化しやすくなり、屈折による光路変更も大きくなって正面方向の光量が低下し、表示に不利となる。また板状体の断面形状においても対向端側の薄型化が困難となり、光出射手段への入射光量も減少して発光効率も低下しやすくなる。

【００２９】伝送光の平行光化による出射光の集光化や正面方向の光量増加、漏れ光の抑制等の前記性能などの点より、緩斜面等の好ましい傾斜角は、８度以下、就中５度以下である。上記の如く光路変換斜面と平坦面ないし緩斜面の当該傾斜角を調節することにより、出射光に指向性をもたせることができ、それにより下面に対して垂直方向ないしそれに近い角度で光を出射させることが可能になる。

【００３０】板状体上面の当該緩斜面を介した表示光の視認性などの点より、好ましい緩斜面は、その傾斜角θ２の角度差を板状体の全体で、従って傾斜角の最大値と最小値の差で、５度以内、就中４度以内、特に３度以内としたものであり、最寄りの緩斜面間における傾斜角θ２の差を１度以内、就中０．３度以内、特に０．１度以

内としたものである。これにより、透過する緩斜面の傾斜角θ２の相違等により表示光が受ける影響を抑制することができる。緩斜面による透過角度の偏向が場所によって大きく相違すると不自然な表示光となり、特に近接画素の近傍における透過像の偏向差が大きいと著しく不自然な表示光となりやすい。

【００３１】前記した傾斜角θ２の角度差は、緩斜面の傾斜角が上記した１０度以下にあることを前提とする。すなわち斯かる小さい傾斜角θ２として緩斜面透過時の屈折による表示光の偏向を抑制して許容値内とすることを前提とするものであり、これは観察点を垂直方向近傍に設定して最適化した液晶表示装置の最適視認方向を変化させないことを目的とする。

【００３２】表示光が偏向されると最適視認方向が垂直方向近傍からズレると共に、表示光の偏向が大きいと導光板上面からの漏れ光の出射方向に近付いてコントラストの低下などその影響を受けやすくなる場合もある。なお緩斜面等の傾斜角θ２を１０度以下とする条件には、透過光の分散等の影響も無視できる程度のものとすることなども含まれている。

【００３３】また明るい表示光を得る点よりは、外光の入射効率に優れ、液晶セルによる表示光の透過光率ないし出射効率に優れるものが好ましい。斯かる点より、下面の基準平面に対する平坦面ないし緩斜面の投影面積が光路変換斜面のそれの５倍以上、就中１０倍以上、特に１５倍以上の光出射手段（凹部又は凸部）とすることが好ましい。これにより、液晶セルによる表示光の大部分を平坦面ないし緩斜面を介して透過させることができる。

【００３４】なお液晶セルによる表示光の透過に際して、光路変換斜面に入射した表示光は入射側面の側に反射されて上面より出射しないか、下面に対する法線を基準に緩斜面等を透過した表示光とは反端側の大きく異なる方向に偏向されて出射し、緩斜面等を介した表示光に殆ど影響を及ぼさない。

【００３５】よって表示光の透過不足で不自然な表示となることを防止する点などより、画素と光路変換斜面がオーバーラップする面積を小さくして、緩斜面等を介した充分な光透過率を確保することが好ましい。一般に液晶セルの画素ピッチは、１００～３００μｍであることを鑑みた場合、前記の点より光路変換斜面は、下面の基準平面に対する投影幅に基づいて４０μｍ以下となるように形成されていることが好ましい。斯かる投影幅は、光路変換斜面を目立ち難くして液晶表示の視認性の向上にも有効である。なお投影幅は、光路変換斜面の投影における短辺方向の長さを意味する。

【００３６】一方、光路変換斜面の投影幅が小さくなるほどその形成に高度な技術が必要となり、凹部又は凸部の頂部が一定以上の曲率半径からなる丸みをもつと、散乱効果が現れて表示光の乱れの原因となりやすく、また一般に蛍光管のコヒーレント長が２０μｍ程度とされている点などよりも、光路変換斜面の投影幅が小さくなると回折等による表示品位の低下原因となりやすいことなどより、特に好ましい光路変換斜面の投影幅は１～２０μｍ、就中５～１５μｍである。

【００３７】なお前記した、光出射手段ないし上面を形成する光路変換斜面や緩斜面、急斜面や平坦面等の面の交点における丸みによる散乱の抑制の点より、その丸みの曲率半径の和が光出射手段の深さ又は高さの１／４以下、就中１／６以下であることが好ましい。これによれば、光出射手段における正反射も低下できて、その視覚性を低減することもできる。

【００３８】前記の点より光路変換斜面の間隔は大きいことが好ましいが、一方で光路変換斜面は上記したように側面入射光の実質的な出射機能部分であるから、その間隔が広すぎると点灯時の照明が疎となってやはり不自然な表示となる場合がある。

【００３９】従って前記を鑑みた場合、図１、２の例の如く光出射手段（凹部又は凸部）のピッチＰ、特に図１の如き隣接構造の場合のピッチＰは、５０μｍ～１．５ｍｍとすることが好ましい。なおピッチは、一定であってもよいし、例えばランダムピッチや所定数のピッチ単位をランダム又は規則的に組合せたものなどの如く不規則であってもよい。斯かるピッチは、光出射手段、特にその光路変換斜面を目立ち難くして液晶表示の視認性の向上にも有効であり、この点よりはピッチを小さくするほど有利である。

【００４０】凹部又は凸部からなる光出射手段の場合、液晶セルの画素と干渉してモアレを生じる場合がある。モアレの防止は、凹部又は凸部のピッチ調節で行いうるが、上記したように凹部又は凸部のピッチには好ましい範囲のあるときがある。従ってそのピッチ範囲でモアレが生じる場合の解決策が問題となる。

【００４１】本発明においては、画素に対し凹部又は凸部が交差状態となるように、凹部又は凸部を入射側面の基準平面に対し傾斜状態に形成して、モアレを防止する方式が好ましい。その場合、傾斜角が大きすぎると、光路変換斜面等を介した反射に偏向を生じて出射光の方向に大きな偏りが発生し、導光板の光伝送方向における発光強度の異方性が大きくなって光利用効率も低下し、表示品位の低下原因となりやすい。

【００４２】前記の点より入射側面の基準平面に対する凹部又は凸部の傾斜角は、上面側から見たときに、光路変換斜面に対する法線と入射側面に対する法線との交差角度に基づいて、０～３０度、就中２８度以下、特に２５度以下とすることが好ましい。液晶セルの解像度が低くてモアレを生じない場合や、モアレを無視しうる場合には凹部又は凸部の長辺方向は、入射側面に平行なほど好ましい。

【００４３】モアレ防止の点より有利な光出射手段は、

図２の例の如く光路変換斜面Ａ１と急斜面Ａ３からなる横断面三角形の凹部又は凸部を間隔をおいて分布させたものである。その分布は、規則的であってもよいし、不規則であってもよい。モアレ防止には不規則な分布が有利である。また輝度の均一化を目的に入射側面より遠離るほど密に配置した分布であってもよい。

【００４４】さらに光出射手段の光路変換斜面は、光源に対面していることが光出射効率の向上の点より好ましいことから、例えば冷陰極管のような線状光源を入射側面に配置する場合には、光路変換斜面の長辺方向を入射側面に可及的に平行に配置した分布であってもよいし、光源の長さが短い場合には、光源の端部近傍における光路変換斜面については、その長辺方向が光源側を向くように、入射側面に対し傾斜させた分布であってもよい。さらに光源が発光ダイオードのような点光源の場合には、光路変換斜面の長辺方向が点光源と対面するようにピット状に配置した分布であってもよい。

【００４５】光路変換斜面と急斜面からなる光出射手段は、視覚され難くする点よりも有利である。その場合には、下面の基準平面に対する急斜面の傾斜角を６０度以上、就中６５度以上、特に７０～９０度とすることが好ましい。また光出射手段の上面に占める面積を１／５以下、就中１／１０～１／５０、特に１／１５～１／３０とすることが好ましい。

【００４６】前記の場合、外光モードと点灯モードにおける明るさをバランスさせる点より、光出射手段の大きさを、その下面に対する投影に基づいてその長辺方向の長さを短辺方向の長さの５倍以上、就中８～５００倍、特に１０～１００倍とし、長辺方向の長さを１㎜以下、就中１０～５００μm、特に２０～３００μmとすることが好ましい。

【００４７】板状体は、上記したように適宜な形態とすることができる。楔形等とする場合にもその形状は適宜に決定でき、直線面や曲面などの適宜な面形状とすることができる。また光出射手段を形成する光路変換斜面や緩斜面等についても直線面や屈折面や湾曲面等の適宜な面形態とすることができる。

【００４８】さらに光出射手段を形成する凹部又は凸部は、ピッチに加えて形状等も異なるものの組合とすることもできる。加えて凹部又は凸部は、図３ａ、ｂの例の如く稜線が連続した一連のものであってもよいし、図３ｃの如く所定の間隔を有して稜線方向に不連続に配列した断続的なものであってもよい。

【００４９】板状体における下面や入射側面の形状については、特に限定はなく、適宜に決定してよい。一般には可及的に平滑でフラットな下面及びその下面に対して垂直な入射側面とされる。入射側面については、例えば湾曲凹形などの光源の外周等に応じた形状として、入射光率の向上をはることもできる。さらに光源との間に介在する導入部を有する入射側面構造などとすることもできその導入部は、光源などに応じて適宜な形状とすることができる。また板状体の外形は、矩形が一般的であるがこれに限定されない。

【００５０】板状体は、光源の波長域に応じそれに透明性を示す有機や無機の適宜な材料にて形成しうる。ちなみに可視光域では、例えばアクリル系樹脂やポリカーボネート系樹脂、ノルボルネン系樹脂やポリオレフィン系樹脂、ポリエステル系樹脂やポリウレタン系樹脂、エポキシ系樹脂等で代表される透明樹脂やガラスなどがあげられる。無機材料と有機材料の組合わせ物であってもよい。複屈折を示さないか、複屈折の小さい材料で形成した板状体が好ましく用いられる。

【００５１】板状体は、切削法にても形成でき、適宜な方法で形成することができる。量産性等の点より好ましい製造方法としては、熱可塑性樹脂を所定の形状を形成しうる型に加熱下に押付て形状を転写する方法、加熱溶融させた熱可塑性樹脂あるいは熱や溶媒を介して流動化させた樹脂を所定の形状に成形しうる型に充填する方法、熱や紫外線ないし放射線等で重合処理しうる液状樹脂やオリゴマーやモノマー等を所定の形状を形成しうる型に充填ないし流延して重合処理する方法などがあげられる。

【００５２】また所定の形状に成形しうる型に前記の液状樹脂等を充填し、その上に透明樹脂板を静置して当該充填層を重合処理する方法や、透明樹脂板に前記の液状樹脂等を塗布しその塗布層を所定の形状に成形しうる型を介し成形した後、その成形層を重合処理する方法などもあげられる。前記の場合、透明樹脂板に代えて透明フィルム等を用いて重合処理した後、所定の形状に打抜き方式等の適宜な方式で裁断し、そのフィルムを接着剤等を介し透明樹脂板に接着する方法なども採ることができる。

【００５３】従って板状体は、前記した光の伝送を担う導光部（樹脂板）に、光出射手段を形成したフィルム等を接着したものの如く、同種又は異種の材料からなる部品の積層体などとして形成されていてもよく、１種の材料による一体的単層物として形成されている必要はない。

【００５４】板状体の厚さは、使用目的による導光板のサイズや光源の大きさなどにより適宜に決定することができる。液晶表示装置等の形成に用いる場合の一般的な厚さは、その入射側面に基づき１０㎜以下、就中０．１～５㎜、特に０．３～３㎜である。また明るい表示を達成する点などより好ましい板状体は、上下面方向の入射光、特に下面から上面への垂直入射光の全光線透過率が９０％以上、就中９２％以上、特に９５％以上で、ヘイズが３０％以下、就中１５％以下、特に１０％以下のものである。

【００５５】図１、図２の例の如く板状体１の下面には、その板状体よりも屈折率が０．０７以上低く、かつ

接着剤層とは別体の透明層１Ｂを介して、少なくとも偏光子を具備する光学シート１Ｃが配置され、これにより導光板が形成される。斯かる低屈折率の透明層１Ｂは、輝度とその均一性に優れる導光板を得ることを目的とする。

【００５６】すなわち板状体の下面にそれよりも屈折率の低い層を設けることで、図２等において光源２からの入射光が板状体１の内部を伝送される際に、その伝送光を板状体１と透明層１Ｂとの屈折率差を介し全反射させて板状体内に効率よく閉じ込めて、伝送光を対向の側面側（後方）に効率よく伝送し、光源から遠い位置における光出射手段Ａの光路変換斜面Ａ１にも伝送光を均等性よく供給し、その斜面による反射を介し光路変換して、光出射面全体における明るさの均一性の向上を目的とする。

【００５７】また低屈折率の透明層は、前記の伝送光が光学シートに入射して減衰や複屈折を受け、それにより伝送状態が部分的に変化して伝送光が減少したり不均一化することの防止なども目的とする。すなわち伝送光が光学シートに入射すると、偏光子で吸収されて減衰する。また位相差板を付加した光学シートではその位相差板による位相差により、偏光子を介した直線偏光が楕円偏光となり、偏光子に再入射した際に吸収され減衰する。

【００５８】前記伝送光の減衰は、そのまま出射光量の減少となり、照明光が暗くなって液晶表示装置の表示が暗くなる。また伝送距離に応じて減衰も大きくなり、光源から遠くなるほど照明光が暗くなり、明るさの均一性が低下する。従って低屈折率の透明層を介し伝送光の光学シートへの入射を抑制することで前記の減衰等が防止される。

【００５９】低屈折率の透明層は、板状体を形成する材料よりも０．０７以上屈折率の低い例えば無機系や有機系の低屈折率誘電体、特にフッ素含有化合物やシリコーン系樹脂の如き適宜な材料を用いて、真空蒸着方式やスピンコート方式などの適宜な方式で、接着剤層とは別体のものとして形成することができ、その材料や形成方法について特に限定はない。なお粘着剤等の接着剤にて低屈折率の透明層を形成する方式では、その低屈折率化で粘着剤等の接着剤の接着特性が低下し、接着目的が達成されない。

【００６０】伝送光の全反射による後方への伝送効率等の点より、低屈折率透明層と板状体の屈折率差は、大きいほど有利であり、就中０．１以上、特に０．２～０．４であることが好ましい。斯かる程度の屈折率差では外光モードによる表示品位に殆ど影響しない。ちなみに当該屈折率差が０．１の場合、その界面での外光の反射率は０．１％以下であり、その反射損による明るさやコントラストの低下は極めて小さいものである。

【００６１】低屈折率の透明層は通例、板状体に直接設けられる。その場合、板状体における透明層の付設面、従って板状体の下面は平滑なほど、よって透明層は平滑なほど伝送光の散乱防止に有利で好ましく、また表示光への影響防止の点よりも好ましい。

【００６２】低屈折率の透明層の厚さは、薄すぎると波動のしみだし現象で上記した閉じ込め効果に薄れる場合があることより、全反射効果の維持の点より厚いほど有利である。その厚さは、全反射効果等の点より適宜に決定しうる。一般には、波長３８０～７８０nmの可視光に対する、特に短波長側の波長３８０nmの光に対する全反射効果等の点より、屈折率×層厚で算出される光路長に基づいて１／４波長（９５nm）以上、就中１／２波長（１９０nm）以上、特に１波長（３８０nm）以上の厚さであることが好ましく、さらには６００nm以上の厚さであることが好ましい。

【００６３】図例の如く、低屈折率透明層１Ｂの下面に設ける光学シート１Ｃは、少なくとも偏光子１Ｃ１を具備するものとされる。これにより偏光を出射する導光板とすることができる。偏光子としては、直線偏光を出射する適宜なものを用いることができ、特に限定はない。

【００６４】ちなみに偏光子の例としては、ポリビニルアルコール系フィルムや部分ホルマール化ポリビニルアルコール系フィルム、エチレン・酢酸ビニル共重合体系部分ケン化フィルムの如き親水性高分子フィルムにヨウ素や二色性染料等の二色性物質を吸着させて延伸したフィルム、ポリビニルアルコールの脱水処理物やポリ塩化ビニルの脱塩酸処理物の如きポリエン配向フィルムなどの偏光フィルムがあげられる。

【００６５】また偏光子は、図例の如く前記偏光フィルム１Ｃ１の片面又は両面に耐水性等の保護目的で、樹脂の塗布層やフィルムのラミネート層等からなる透明保護層１Ｃ２、１Ｃ２’を有するものであってもよい。さらに液晶ポリマーや液晶含有のポリマーからなる偏光層を有する偏光子などもあげられる。透過率の高い偏光子が明るい表示等の点より好まし用いられる。

【００６６】光学シートは、図例の如く偏光子１Ｃ１の片側に１層又は２層以上の位相差板１Ｃ３、１Ｃ４を具備するものであってもよい。その位相差板としては、適宜な位相差を示すものを用いうる。従って１／４波長板、例えば図例の如く位相差が１００～１５０nmの位相差板１Ｃ４を用いて、上記した円偏光板からなる反射防止層として機能する光学シートとすることもできる。位相差板を付加した光学シートは、液晶セルに偏光子や位相差板を別々に接着する工程を省くことができ、液晶表示パネルの組立て効率の向上に有利である。

【００６７】前記した光学シートにおける偏光子を利用して、円偏光板からなる反射防止層として機能するものとすることにより、多層薄膜等からなる別体の反射防止層を設ける必要なく、導光板の下面及び液晶表示パネルの表面で生じる外光や照明光の反射を抑制して、液晶表

示のコントラスト低下を防ぐことができる。

【００６８】すなわち前記の円偏光板によれば、板状体の下面より出射した光が導光板よりも下面側で反射される場合に、偏光子による直線偏光が１／４波長板を透過した際に円偏光化されて導光板を透過し、導光板の下面側で反射される際に円偏光の位相が反転し、その反射光が１／４波長板に再入射して直線偏光とされるため、偏光子に再入射する際には位相の反転効果で吸収される方向の直線偏光となっており偏光子を透過できず、反射防止が達成される。

【００６９】前記の結果、点灯・外光両モードにおいてフロント配置の導光板を透過して、その下面側で反射された光が導光板を再透過して上面からの漏れ光として出射することを阻止し、表示光との重複によるコントラスト等の低下を防止することができる。なお円偏光板としての光学シートは、前記した反射光の透過防止の点より、偏光子の光軸と１／４波長板の遅相軸が３５～５５度、就中４０～５０度、特に４５度の角度で交差するように配置されていることが好ましい。

【００７０】前記の反射防止層を形成する場合、光学シートは、１／４波長板、就中、位相差が１００～２００nm、特に１００～１５０nmの位相差板を少なくとも１枚有することが必要である。反射防止層として好ましい光学シートは、図例の如く位相差が１００～１５０nmの位相差板１Ｃ４と、１／２波長板、就中、位相差が２００～３００nmの位相差板１Ｃ３をそれぞれ１層又は２層以上有するものである。なお反射防止層を形成する場合、斯かる位相差板は、図例の如く偏光子の片側に配置され、かつその光学シートは、偏光子が板状体側に位置するように配置される。

【００７１】前記した１／２波長板の付加は、円偏光板としての波長域の拡大を目的とする。すなわち１／４波長板による上記した位相反転は、円偏光化度の高いほどその効果が高い。一般に１／４波長板のみでは、その位相差に波長分散が発生して全波長域で良好な円偏光とならず、１／２波長板と組合せることで殆どの可視光域で良好な円偏光とすることができる。斯かる点より１／２波長板の配置位置は、図例の如く偏光子１Ｃ１と１／４波長板１Ｃ４の間とすることが好ましい。その場合、１／２波長板の遅相軸が１／４波長板の遅相軸と異なる角度となるように配置するか、１／４波長板とは異なる波長分散特性を示すものと組合せるか、それらを併用する方式にて位相反転の波長域を安定して拡大することができる。

【００７２】なお前記の角度を相違させた配置では、偏光子の光軸と１／２波長板の光軸が５～２５度の角度で交差し、かつその交差角をθとしたとき１／４波長板の光軸が$2\theta+35$～$2\theta+55$度、就中$2\theta+40$～$2\theta+50$度の角度範囲で交差する関係とすることが位相反転の波長域拡大の点から好ましい。特に１／４波長板又は１／２波長板を複数用いる場合、良好な円偏光を作りうる波長の範囲を広くでき、より広い波長域で反射防止効果を発揮させる点より好ましい。なお厚さ方向の屈折率を制御した位相差板を用いて、液晶表示装置や反射防止可能な視野角を広くしたり、故意に狭くしたりすることもできる。

【００７３】１／４波長板や１／２波長板、ないし位相差板としては、各種の樹脂からなる延伸フィルムや液晶ポリマーの配向層を有するもの、無機結晶からなるものなどの適宜なものを用いうる。前記の延伸フィルムは、自由端や固定端による一軸延伸、二軸延伸、熱収縮性フィルムの接着下に加熱処理する方式などで厚さ方向にも分子配向させる延伸などの各種の方式で延伸処理したものであってよい。

【００７４】光学シートは、それを図例の如く、板状体１の下面に低屈折率透明層１Ｂを介して接着するための接着層１Ｃ５を有していてもよい。上記した反射防止層として機能する光学シートの場合、斯かる接着層１Ｃ５は、図例の如く偏光子１Ｃ１の側に設けられる。接着層を形成する接着剤としては、光透過性の適宜なものを用いうる。接着作業の簡便性の点よりは、アクリル系やゴム系で代表される粘着剤が好ましく用いられる。

【００７５】本発明による導光板によれば、上面及び下面からの入射光が下面又は上面より良好に透過し、それを用いて精度よく平行化された偏光を視認に有利な垂直性に優れる方向に出射し、光源からの光を効率よく利用して明るさに優れる偏光面光源装置、さらには明るくて見やすく低消費電力性に優れる反射型液晶表示装置などの種々の装置を形成することができる。

【００７６】図４に本発明による導光板を有する偏光面光源装置１０を例示した。偏光面光源装置は、例えば図例の如く導光板における板状体１の入射側面に光源２を配置することにより形成でき、サイドライト型のフロントライト等として好ましく用いうる。

【００７７】光源としては、適宜なものを用いうる。一般には例えば（冷，熱）陰極管等の線状光源、発光ダイオード等の点光源や、それを線状や面状等に配列したアレイ体、あるいは点光源を一定又は不定間隔の線状発光状態に変換する装置を用いた光源などが好ましく用いうる。低消費電力性や耐久性等の点よりは、冷陰極管が特に好ましい。光源は、板状体の１又は２以上の入射側面に配置することができる。

【００７８】偏光面光源装置の形成に際しては、必要に応じて図４、５の例の如く光源２からの発散光を板状体１の入射側面に導くために、光源を包囲するランプリフレクタ３などの適宜な補助手段を配置した組合せ体とすることもできる。ランプリフレクタとしては、高反射率金属薄膜を付設した樹脂シートや金属箔などが一般に用いられる。ランプリフレクタを板状体の端部に接着剤等を介し接着して光源の保持手段とする場合には、その接

着部分については光出射手段の形成を省略することもできる。

【００７９】上記のように本発明による偏光面光源装置は、光の利用効率に優れて明るくて垂直性に優れる偏光を提供し、大面積化等も容易であることより反射型液晶表示装置等におけるフロントライトなどとして種々の装置に好ましく適用でき、明るくて見やすく低消費電力の反射型液晶表示装置等を得ることができる。

【００８０】フロントライト式の反射型液晶表示装置は、偏光面光源装置の光出射側に、従って導光板の下面側に反射層を有する液晶セルを配置することより形成でき、その例を図５に示した。１０が偏光面光源装置であり、２０が反射層を有する液晶セルを具備する液晶表示パネルである。２０１、２０５がセル基板で、２０３がセル基板間に狭持された液晶層、２０２が電極兼用の反射層で、２０４が透明電極である。

【００８１】反射型液晶表示装置１００は一般に、電極を具備して液晶シャッタとして機能する液晶セルとそれに付随の駆動装置、偏光子、フロントライト、反射層及び必要に応じての補償用位相差板や光拡散層等の構成部品を適宜に組立てることなどにより形成される。本発明においては、上記した偏光子具備の偏光面光源装置を用いる点を除いて特に限定はなく、図例の如く従来に準じて形成することができる。

【００８２】従って用いる液晶セルについては、特に限定はない。就中、円偏光ないし楕円偏光モードで表示するものが好ましい。その場合、液晶表示パネルには別体の偏光子を設けないことが明るい表示の点より好ましい。また光学シートが反射防止タイプである場合には、導光板下面での反射と液晶セル表面での反射を防止できるので、例えば高分子分散型のような偏光を利用しないタイプの液晶セルも好ましく用いうる。従って液晶セルとしては、例えばＴＮ液晶セルやＳＴＮ液晶セル、垂直配向セルやＨＡＮセル、ＯＣＢセルの如きツイスト系や非ツイスト系、ゲストホスト系や強誘電性液晶系の液晶セルなどの適宜なものを用いうる。

【００８３】また液晶セルにおける液晶の駆動方式についても特に限定はなく、例えばアクティブマトリクス方式やパッシブマトリクス方式などの適宜な駆動方式であってよい。さらにセル基板や電極は、照明光や表示光を透過させる必要のない位置にあるものでは、透明基板や透明電極である必要はなく、不透明体にて形成することもできる。

【００８４】反射型液晶表示装置では反射層の配置が必須であるが、その配置位置については適宜に決定でき、例えば液晶セルの外側に設けることもできるし、図５に例示の如く液晶セルの内側に設けることもできる。後者の反射層２０２を液晶セルの内側に有するものは、パララックスの発生の点で好ましい。

【００８５】反射層は、例えばアルミニウムや銀、金や銅やクロム等の高反射率金属の粉末をバインダ樹脂中に含有する塗工層や、蒸着方式等による金属薄膜の付設層、その塗工層や付設層を基材で支持した反射シート、金属箔などの従来に準じた適宜な反射層として形成することができる。

【００８６】なお図５の例の如く、液晶セルの内部に反射層２０２を設ける場合、その反射層は、前記の高反射率金属等の高導電性材料にて電極を兼ねるものとして形成することもできるし、透明電極等と併設することもでき、また透明電極にて形成することもできる。

【００８７】光拡散層は、明暗ムラの防止による明るさの均等化や隣接光線の混交によるモアレの低減などを目的に必要に応じて設けられる。光拡散層としても適宜なものを用いることができる。ちなみにその例としては低屈折率の透明樹脂中に高屈折率の透明粒子を分散させた塗布硬化層や、気泡を分散させた透明樹脂の塗布硬化層、基材表面を溶媒を介し膨潤させてクレイズを発生させたものや、不規則な凹部又は凸部面を有する透明樹脂層、あるいはそれらの層を支持基材に設けた拡散シートなどがあげられる。

【００８８】前記の不規則な凹部又は凸部面は、基材やその上に設けた透明樹脂の塗布層の表面に粗面化処理したロールや金型等の粗面形状を転写する機械的方式又は／及び化学的処理方式などの適宜な方式で形成することができる。前記の透明粒子には例えば平均粒径が０．５～３０μmのシリカ、アルミナ、チタニア、ジルコニア、酸化錫、酸化インジウム、酸化カドミウム、酸化アンチモン等の導電性のこともある無機系粒子や、架橋又は未架橋ポリマー等の有機系粒子などの適宜なものを１種又は２種以上用いうる。

【００８９】なお光拡散層は、導光板の光学シートに対しても設けることができ、液晶表示装置の適宜な位置に１層又は２層以上配置することができる。また光拡散層としては表示光を乱さない程度の弱い拡散能を示すものが好ましく用いられる。

【００９０】他方、上記した補償用位相差板は、複屈折の波長依存性などを補償して視認性を向上させることなどを目的とし通例、偏光子と液晶セルの間に必要に応じて配置される。従って、斯かる補償用位相差板を組み入れた光学シートとすることもできる。補償用の位相差板としては、波長域などに応じて適宜なものを用いることができ、１層又は２層以上の位相差層の重畳層として形成されていてもよい。

【００９１】本発明による反射型液晶表示装置の視認は、偏光面光源装置、特に上記したようにその板状体の平坦面ないし緩斜面の透過光を介して行われる。ちなみに図５に例示の液晶セル内に反射層２０２を設けたものの場合の視認では、偏光面光源装置の点灯モードにおいて、導光板下面の光学シート１Ｃより出射した偏光が液晶層２０３等を経由して反射層２０２を介し反射され、

液晶層や光学シート等を逆経由して板状体１に至り、緩斜面Ａ２を透過した表示光が視認される。

【００９２】一方、偏光面光源装置が非点灯の外光モードの場合においても、板状体上面の緩斜面Ａ２より入射した光が光学シートや液晶層等を前記に準じ透過・逆経由して板状体１に至り、緩斜面を透過した表示光が正面方向の近傍で板状体による乱れ等が少ない表示品位に優れる状態で視認することができる。なお偏光面光源装置の点灯・消灯は適宜な方式にて行うことができる。

【００９３】本発明において、上記した導光板や偏光面光源装置、液晶表示装置を形成することのある板状体や偏光子、位相差板や液晶セル等の部品は、全体的又は部分的に積層一体化されて固着されていてもよいし、分離容易な状態に配置されていてもよい。光軸のズレ防止などの点よりは固着状態にあることが好ましい。その固着処理には、粘着剤等の適宜な透明接着剤を用いることができ、その透明接着層に上記した透明粒子等を含有させて拡散機能を示す接着層などとすることもできる。

【００９４】

【実施例】実施例１

予め所定形状に加工したポリメチルメタクリレート板（屈折率１．４９５）の表面をダイヤモンドバイトにて切削し、上面に光出射手段を有する板状体を形成した。その板状体は、幅３０㎜、奥行４２㎜、入射側面の厚さ１．０㎜、対向端の厚さ０．８㎜であり、上下面が平坦である。

【００９５】また光出射手段は、傾斜角４１．５～４３度の光路変換斜面と傾斜角１～２度の緩斜面からなる横断面三角形で、入射側面に平行な連続溝を隣接して２１０μmのピッチで有し（図１、図３ａ）、入射側面と対面する光路変換斜面の下面に対する投影幅が６～９μmであり、緩斜面／光路変換斜面の下面に対する投影面積比が２０／１以上のものであった。また最寄り緩斜面間の傾斜角度差は０．１度以内であった。なお光出射手段は、入射側面より２㎜離れた位置より形成した。

【００９６】次に前記板状体の下面に屈折率１．３８のフッ化マグネシウムを厚さ６１０nmに真空蒸着し、その低屈折率透明層に対しアクリル系粘着層を介し光学シートを接着して、導光板を得た。

【００９７】前記の光学シートは、偏光フィルム（日東電工社製、ＳＥＧ１４２６ＤＵ）と、位相差が２６０nmの位相差フィルムと、位相差が１３０nmの位相差フィルムをアクリル系粘着層を介し順次積層したものからなり、その偏光子を板状体側として接着した。

【００９８】なお光学シートにおける各フィルムの軸方向は、導光板の上面側から見たときに基づいて、導光板の入射側面を０度として、偏光子の吸収軸方向が１５度、内側の位相差フィルムの遅相軸が２８度、外側の位相差フィルムの遅相軸が８６度である。

【００９９】ついで前記導光板の入射側面に直径２㎜の冷陰極管（ハリソン電気社製）を芯対応させて密着配置し、それを銀蒸着を施したポリエステルフィルムからなるランプリフレクタにて包囲して、その縁を導光板の上下端面に両面粘着テープで接着して固定し、偏光面光源装置を得た。なお冷陰極管には入射側面長よりも十分に長いものを用い、その中心部を対応させて配置した。また冷陰極管にインバータ、直流電源を接続し、その電源のオン・オフで点灯／消灯を切り替えうるようにした。

【０１００】その後、前記偏光面光源装置の光学シート側に、液晶セル内に拡散型反射層を有する市販の液晶表示パネルを配置して反射型液晶表示装置を得た。なお液晶表示装置は、全画素をオン／オフさせる駆動式のものであり、市販物よりその偏光子と位相差板を剥離除去して用いた。

【０１０１】実施例２

フッ化マグネシウムからなる低屈折率透明層の厚さを３２０nmとしたほかは、実施例１に準じて導光板、偏光面光源装置及び反射型液晶表示装置を得た。

【０１０２】実施例３

光学シートとして、偏光フィルムと位相差１３０nmの位相差フィルムを積層したものを用いたほかは、実施例１に準じて導光板、偏光面光源装置及び反射型液晶表示装置を得た。なお光学シートにおける各フィルムの軸方向は、導光板の上面側から見たときに基づいて、導光板の入射側面を０度として、偏光子の吸収軸方向が１５度、位相差フィルムの遅相軸が６０度である。

【０１０３】実施例４

異なる光出射手段を有する板状体を用いたほかは、実施例１に準じて導光板、偏光面光源装置及び反射型液晶表示装置を得た。なお板状体は実施例１に準じて形成したものであり、傾斜角が約４２度の光路変換斜面と傾斜角が８０度の急斜面からなる横断面三角形の光出射手段を連続溝として２１０μmのピッチで有する（図３ｂ）。なお光路変換斜面の下面に対する投影幅は６～９μmであり、平坦面（上面）／光路変換斜面の下面に対する投影面積比が１９／１以上のものである。

【０１０４】実施例５

予め所定の形状に形成した金型に、屈折率が１．５１の硬化層を形成する紫外線硬化型アクリル樹脂を流延した後、その上に予め所定の形状に切り出した厚さ１㎜、屈折率１．４９５のアクリル樹脂板を静置し、そのアクリル樹脂板側から紫外線を照射して紫外線硬化樹脂を硬化させ、金型から静かに外して、板状体を得た。

【０１０５】前記の板状体は、その上面には幅が約９μmで傾斜角が４２度の光路変換斜面と傾斜角約８０度の急斜面からなる長さ約１００μmの光出射手段を、入射側面から遠離るほど密に分布させたものからなる（図３ｃ）。なお上面における平坦面／光出射手段の面積比は１９／１以上であった。その板状体を用いたほかは、実施例１に準じて導光板、偏光面光源装置及び反射型液晶

表示装置を得た。

【０１０６】実施例６

低屈折率透明層として、ポリシロキサン系塗布液を硬化後の厚さが８００nmとなるように塗布し、８０℃で３０分間加熱して硬化させたもの（屈折率１．３６）としたほかは、実施例１に準じて導光板、偏光面光源装置及び反射型液晶表示装置を得た。

【０１０７】比較例１

板状体に低屈折率透明層を設けないほかは、実施例１に準じて導光板、偏光面光源装置及び反射型液晶表示装置を得た。

【０１０８】比較例２

板状体に低屈折率透明層を設けないほかは、実施例３に準じて導光板、偏光面光源装置及び反射型液晶表示装置を得た。

【０１０９】比較例３

光路変換斜面の傾斜角を３０度としたほかは、実施例１に準じて導光板、偏光面光源装置及び反射型液晶表示装置を得た。

【０１１０】比較例４

サンドブラストにて粗面化した金型を用いたほかは、実施例１に準じて導光板、偏光面光源装置及び反射型液晶表示装置を得た。

【０１１１】比較例５

低屈折率透明層を設けない板状体を導光板として用いたほかは、実施例１に準じて偏光面光源装置及び反射型液晶表示装置を得た。ただし導光板が光学シートを有しないため、液晶表示パネルは、その偏光子と位相差板を剥離せずに使用した。

【０１１２】比較例６

板状体に低屈折率透明層を設けずに、光学シートを屈折率が１．４２のフッ素含有粘着層を板状体下面に接着したほかは、実施例１に準じて導光板、偏光面光源装置及び反射型液晶表示装置を得た。

【０１１３】評価試験

実施例、比較例で得た白状態の反射型液晶表示装置において、暗室中で偏光面光源装置を点灯して点灯モードとし、導光板の幅方向の中心における入射側面より１０mm、２０mm、３０mmの位置における視認面での正面輝度を輝度計（トプコン社製、ＢＭ－７）にて調べると共に、視認性を目視観察し、かつ黒表示とした場合の当該２０mm位置における正面輝度も調べて、コントラスト比を算出した。

【０１１４】前記の結果を下表に示した。

	正面輝度（ｃｄ／ｍ²）				コントラスト比
	白状態			黒状態	
位置	１０mm	２０mm	３０mm	２０mm	２０mm
実施例１	１２４	１２８	１２１	１０	１２．８
実施例２	１２０	１１６	１１０	９	１２．９
実施例３	１１０	１１７	１１９	１２	９．８
実施例４	１３１	１２７	１２２	９	１４．１
実施例５	１１８	１２１	１２７	１１	１１．０
実施例６	１２０	１３３	１３９	１１	１２．１
比較例１	１２１	９２	６９	１０	９．２
比較例２	１１５	７５	４９	９	８．３
比較例３	４２	５１	５５	１１	４．６
比較例４	１６	２２	２９	１６	１．４
比較例５	１４８	１５３	１５９	２４	６．４
比較例６	１１４	９９	８３	１１	９．０

【０１１５】表より、実施例１と比較例１、実施例３と比較例２の対比から、実施例では輝度が高く、そのバラツキも少なく均一性に優れることがわかる。またコントラスト比の点でも実施例が高く、低屈折率透明層を設けたことによる効果に優れることがわかる。比較例では入射側面から遠離るほど輝度が大きく低下しており、偏光子の吸収による影響が示唆された。

【０１１６】さらに比較例３、４では正面方向で十分な明るさが得られず、斜め方向が最も明るかった。特に比較例４では導光板の上面からの光出射が大きく白ボケた印象であった。このことから本発明による光出射手段以外の形状では良好な光出射が達成できないことがわかる。また比較例５では、実施例１以上の明るさが得られるものの、導光板下面と液晶セル上面での表面反射によって白ボケた印象で、コントラスト比も実施例と比べて大きく低下していた。

【０１１７】一方、コントラスト比においては、比較例４、５で黒状態での輝度が高く、実施例と比べてコントラスト比の小さいことがわかった。目視でも比較例４、５は白ボケて見える。特に比較例４では導光板から直接光が出射し、それ自体が光ってしまっていた。また比較例５では導光板下面と液晶パネル上面からの反射で照明光が液晶パネルに入射する前に反射されて、コントラスト比の低下を引き起こしていることがわかった。さらに比較例６では実施例１と比べ若干コントラスト比の点でも劣っていた。

【０１１８】次に、暗室の照明を点灯させ、液晶パネルを白表示、黒表示として消灯状態で目視観察した。その結果、実施例及び比較例１、２、３、６では特に黒表示でもくっきり見えたのに対して、比較例５では導光板の下面の反射と液晶パネル表面での反射によって表示が白ボケて見えて、見にくかった。また他の例と比べて光源や周囲の映り込みが大きく見にくかった。さらに比較例４では導光板上面の粗面による散乱反射で光が乱反射し、表示が白ボケて見にくかった。また比較例６では粘着剤の接着力が十分ではなく、偏光子が剥れやすくて使いづらかった。

【０１１９】上記より実施例では点灯・外光両モードにおいて、明るくてその均一性に優れる良好な表示品位のフロントライ式反射型液晶表示装置の実現されていることがわかる。

【図面の簡単な説明】

【図１】導光板の断面図

【図２】他の導光板の断面図

【図３】さらに他の導光板の断面図

【図４】偏光面光源装置の断面図

【図５】反射型液晶表示装置の断面図

【符号の説明】

１：板状体

１ａ：平坦面

Ａ：光出射手段

Ａ１：光路変換斜面　Ａ２：緩斜面　Ａ３：急斜面

１Ｂ：低屈折率の透明層

１Ｃ：光学シート

１Ｃ１：偏光子　１Ｃ３、１Ｃ４：位相差板　１Ｃ５：接着層

１０：偏光面光源装置

２：光源

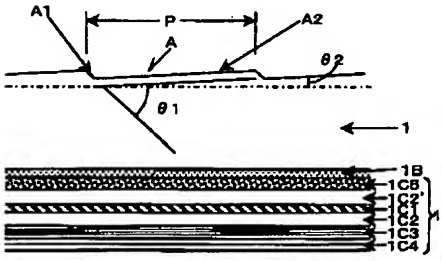
１００：反射型液晶表示装置

２０：液晶表示パネル

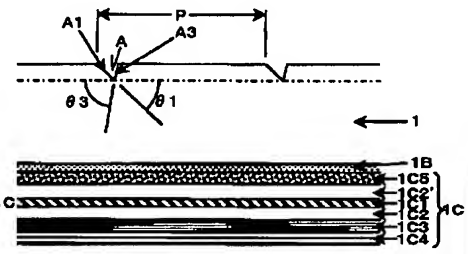
２０１、２０５：セル基板　２０２：電極兼用反射層

２０３：液晶層　２０４：透明電極

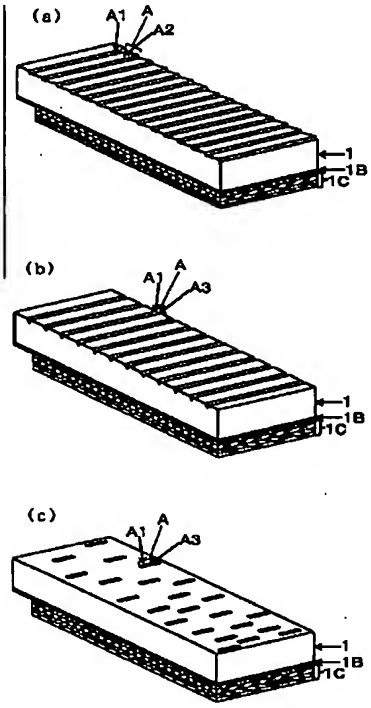
【図１】



【図２】

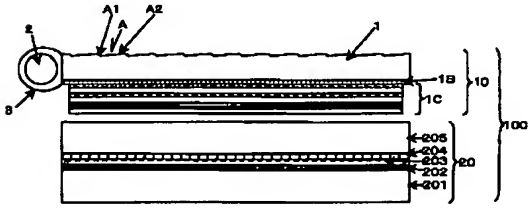


【図３】



【図４】

【図５】



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